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Kikuchi

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(54) **SHEET CUTTING APPARATUS, SHEET AFTERTREATMENT APPARATUS HAVING THE SAME, AND IMAGE FORMING APPARATUS HAVING THE SAME**

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G03G 15/00 (2006.01)

(52) **U.S. Cl.** **400/621**; 83/613; 399/407

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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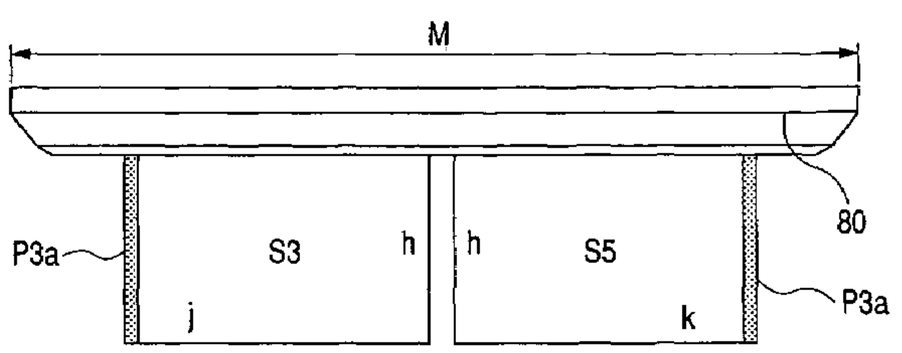
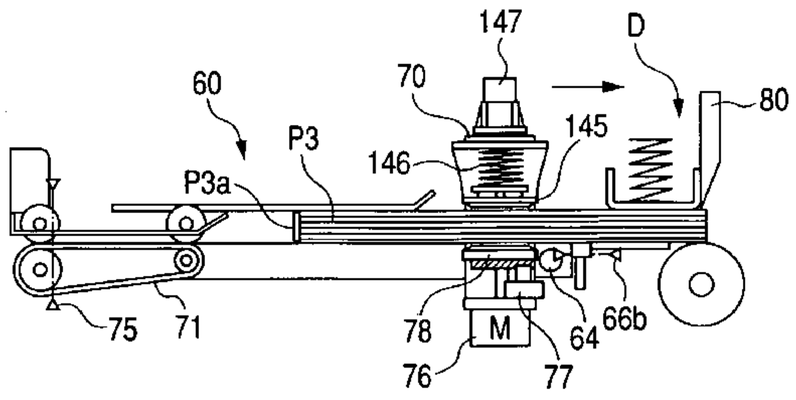
(57) **ABSTRACT**

A sheet cutting apparatus including: a cutting blade for cutting a sheet to be cut, which includes a sheet or a sheet stack; and a transport devices capable of holding and rotating the sheet to be cut to cause an end portion of the sheet to be cut to be opposed to the cutting blade and transporting the sheet to be cut to a position where the end portion is cut by the cutting blade.

5 Claims, 15 Drawing Sheets





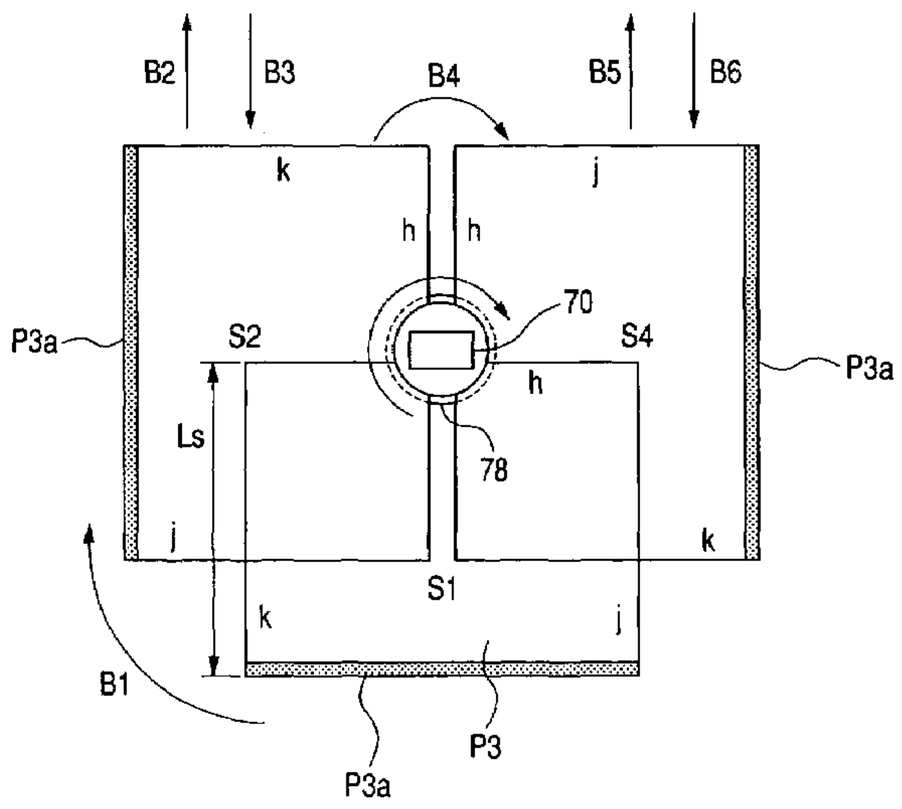
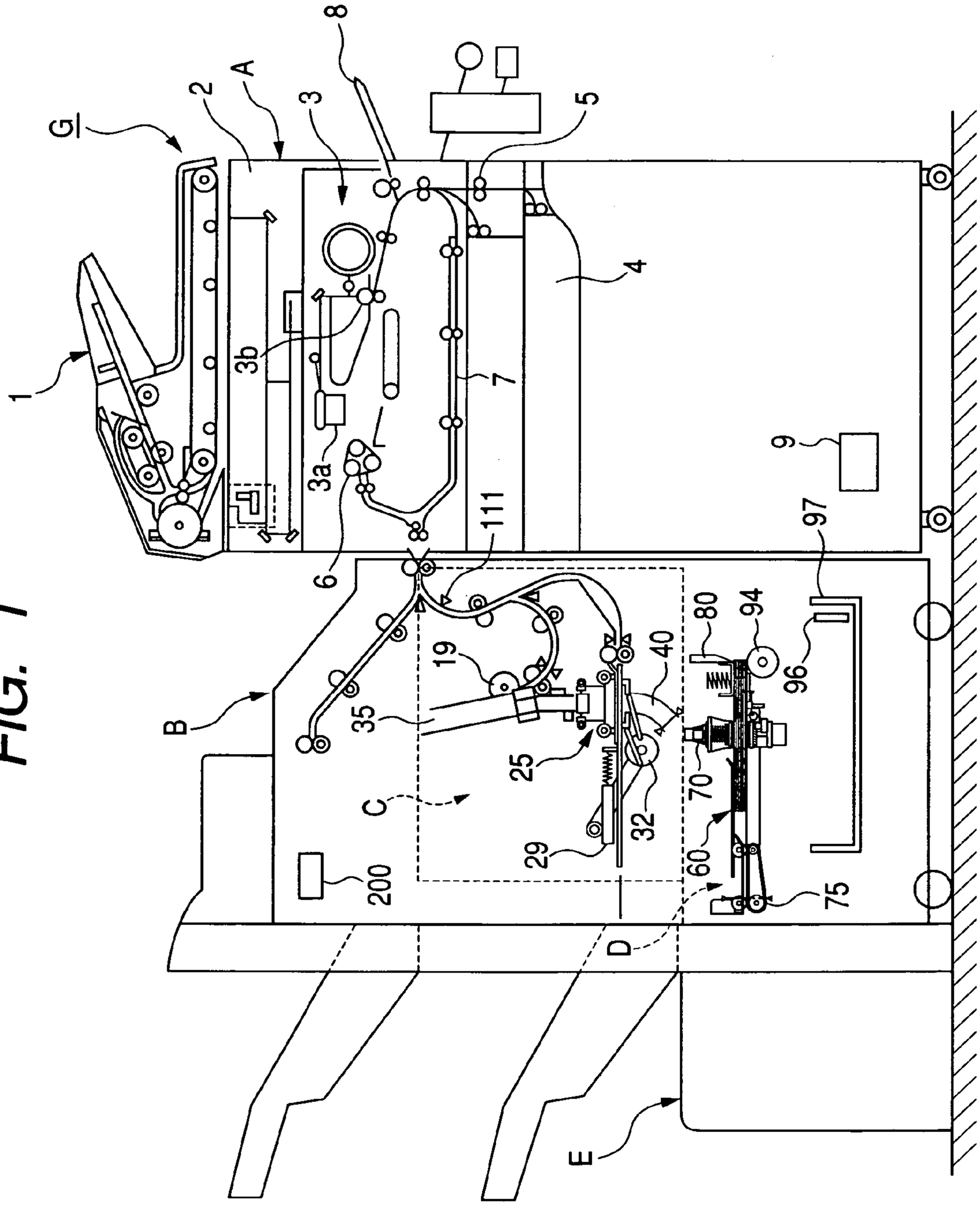


FIG. 1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2
A
3
8
5
4
1
3b
7
3a
6
111
9
97
B
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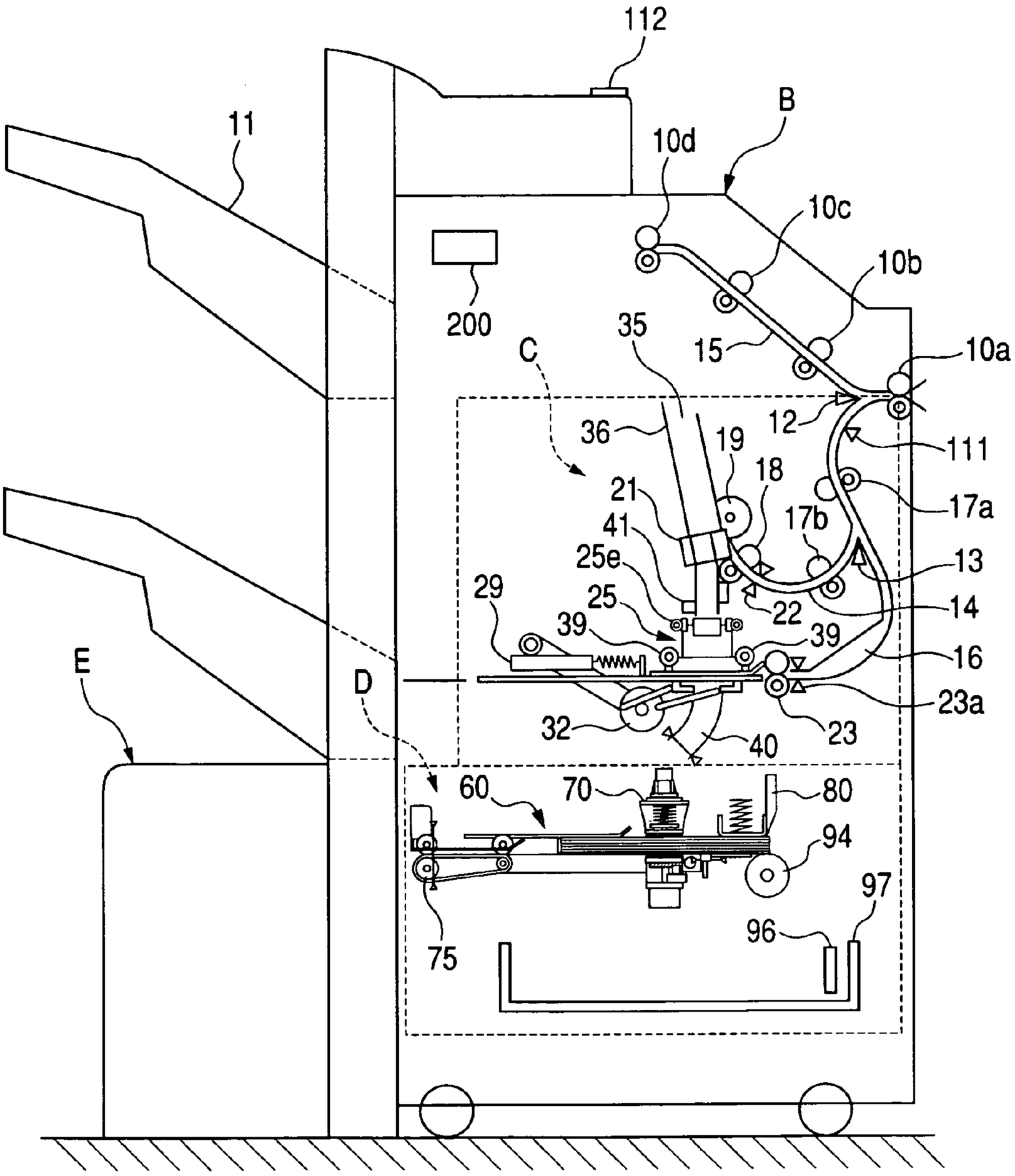
35
40
80
94
96
25
C
70
32
29
60
75
200
D
E

FIG. 2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11
B
10d
10c
10b
10a
200
35
15
C
12
111
36
19
18
21
17a
17b
41
25e
13
29
25
22
14
39
39
16
E
D
23a
32
40
23
60
70
80
94
97
96
75

FIG. 3A

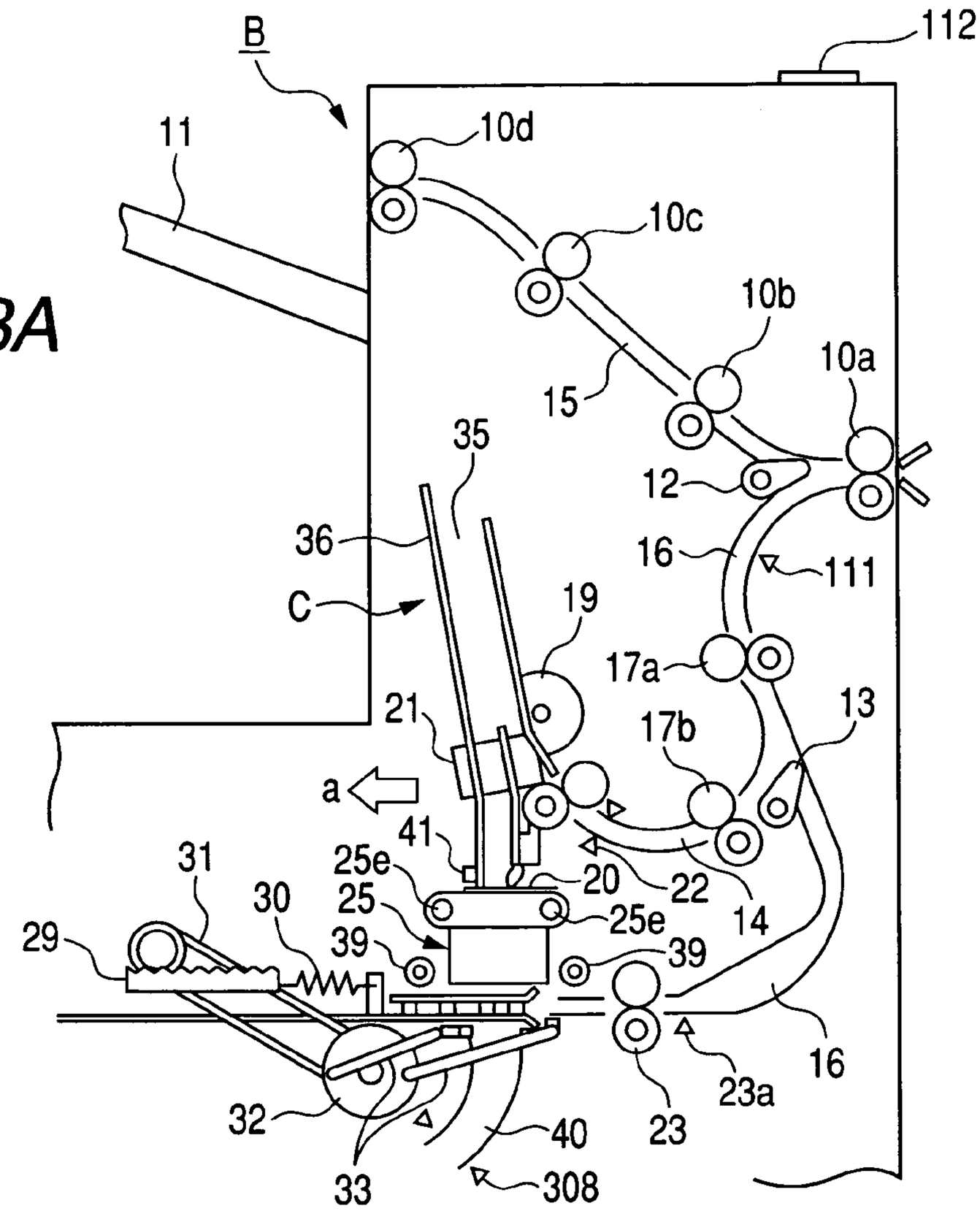

B
112
11
10d
10c
10b
10a
15
12
35
36
16
111
C
19
17a
13
21
17b
a
41
20
22
14
31
25e
30
25
25e
29
39
39
32
40
23
23a
16
33
308

FIG. 3B

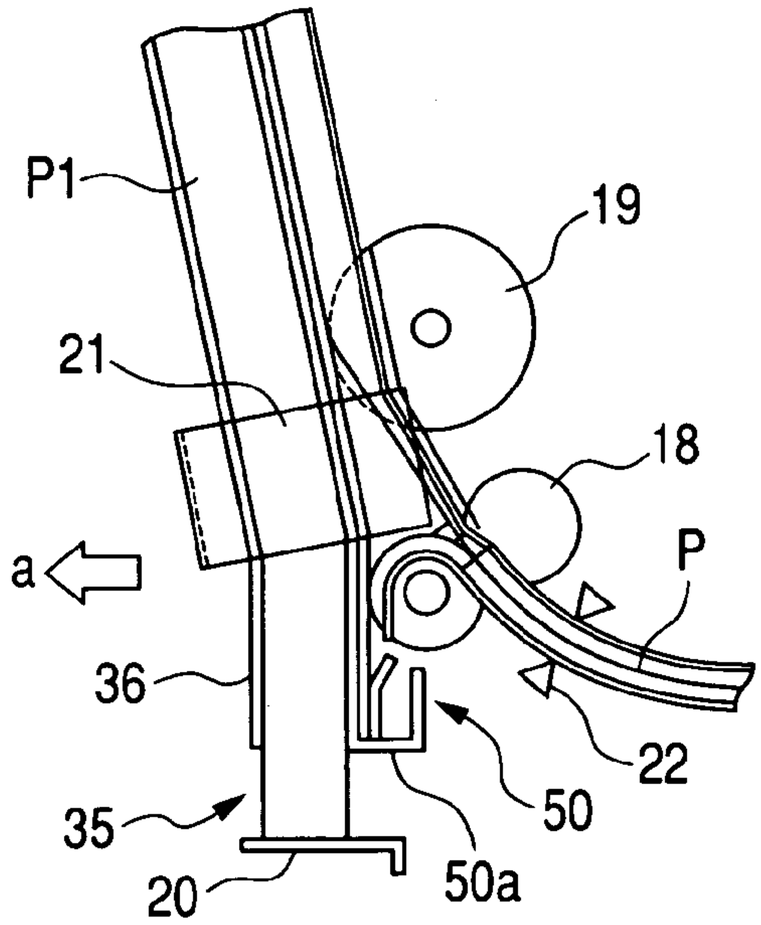

P1
19
21
18
P
a
36
22
50
35
20
50a

FIG. 4

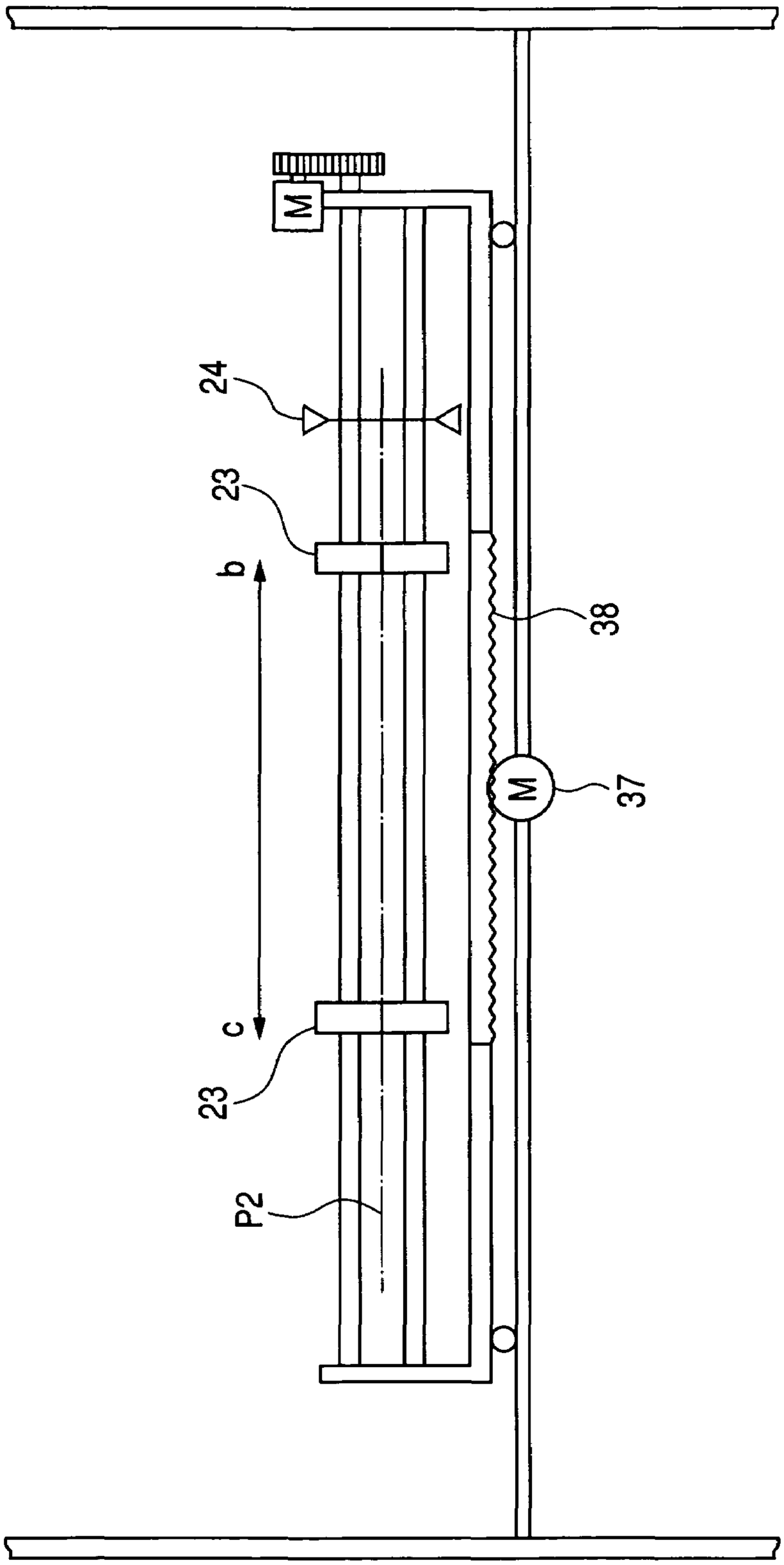


FIG. 5

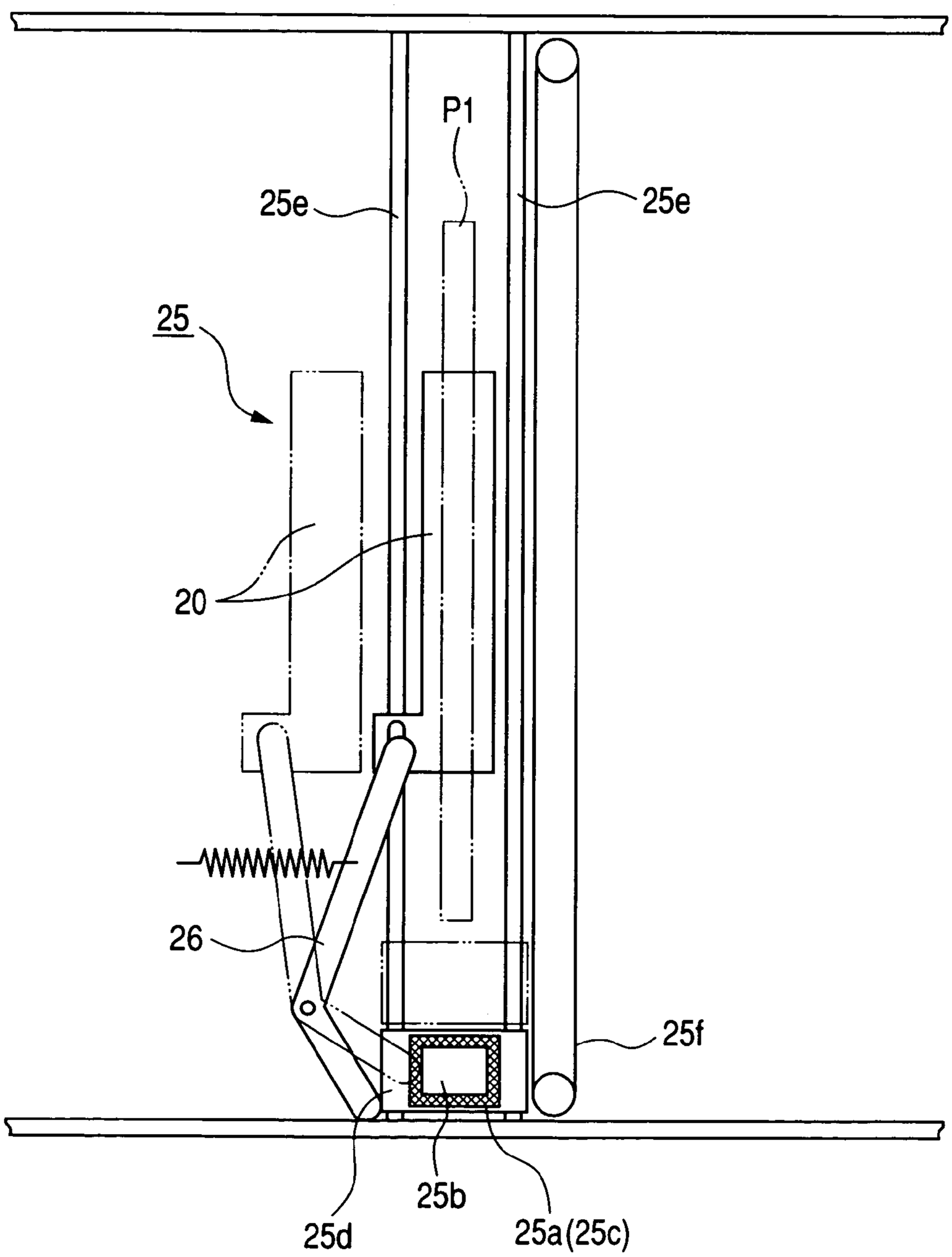


FIG. 6A

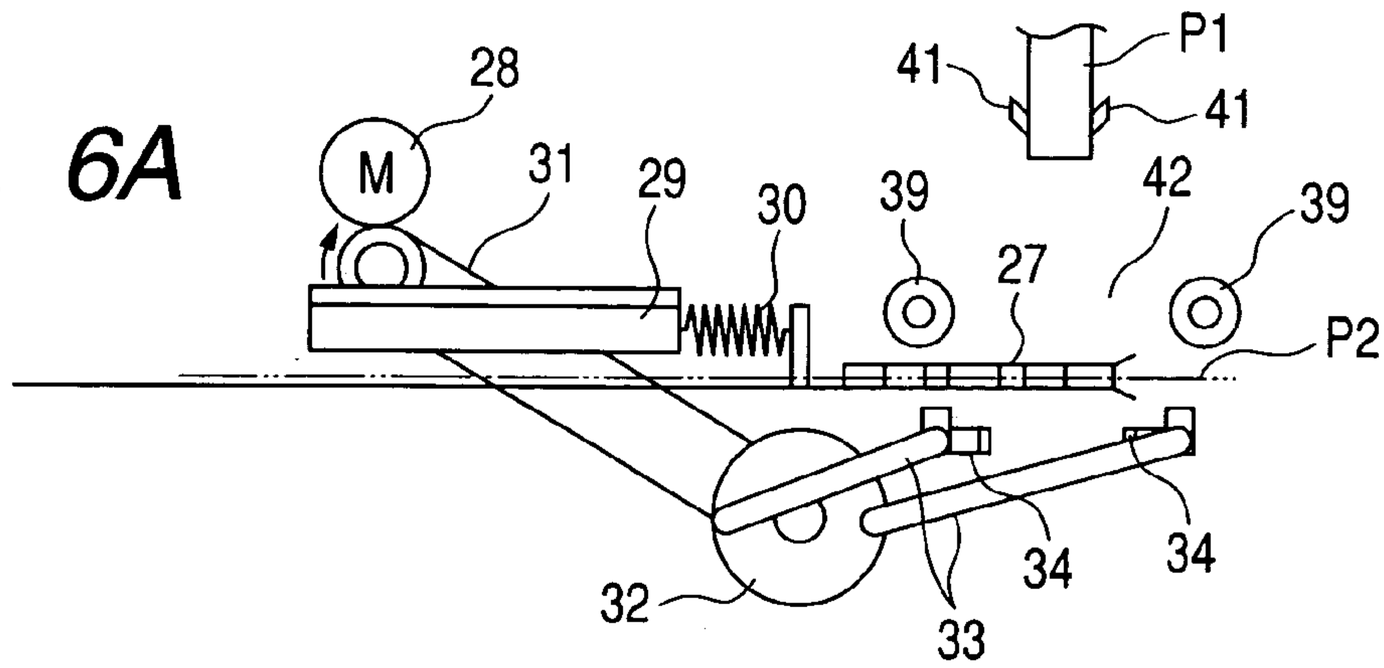


FIG. 6B

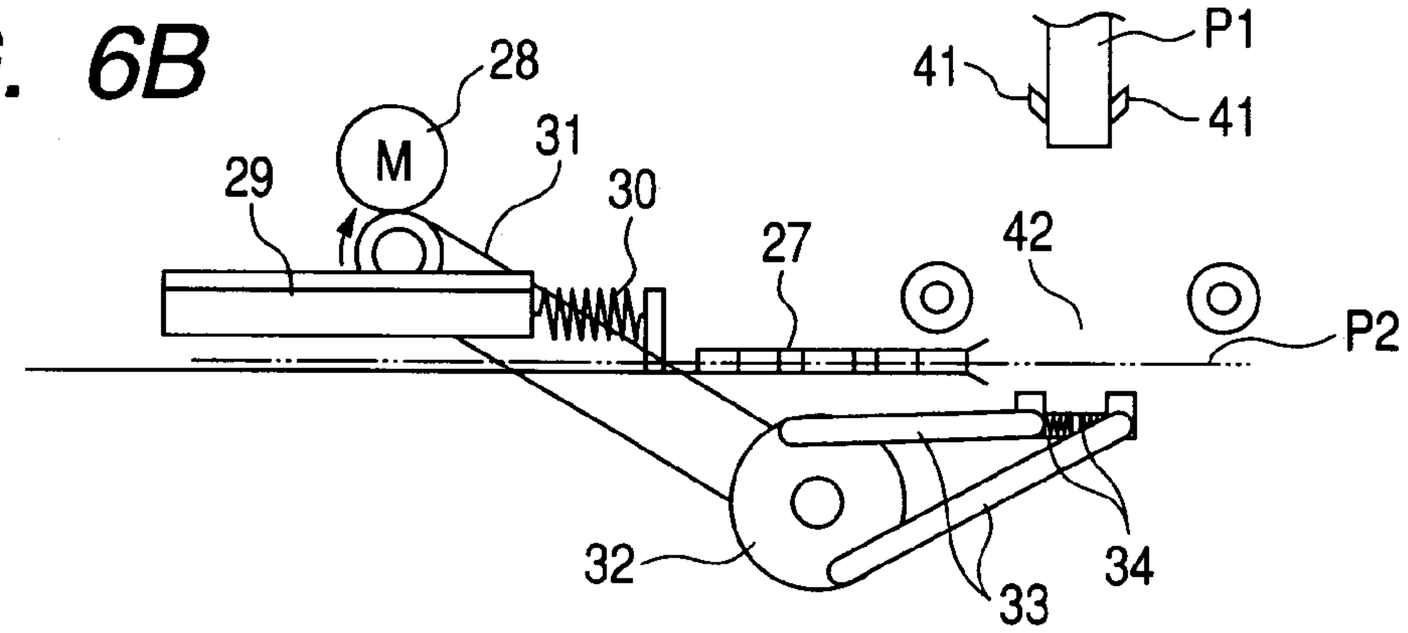


FIG. 6C

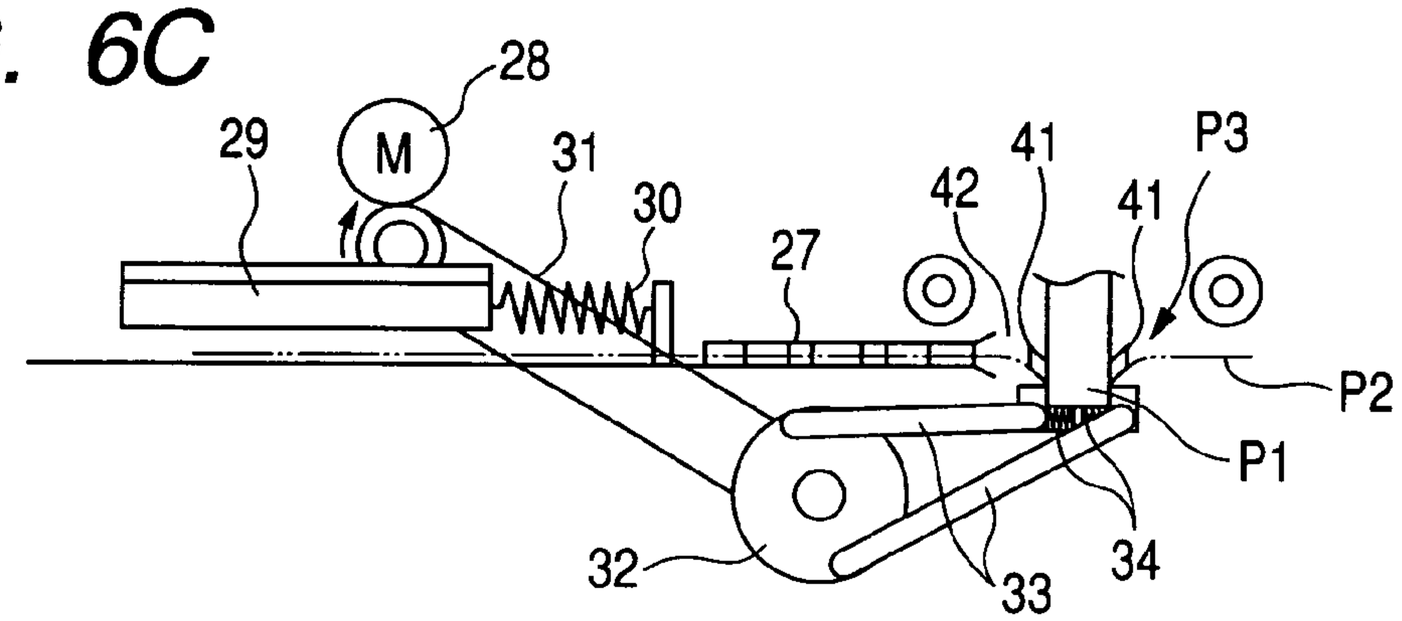


FIG. 6D

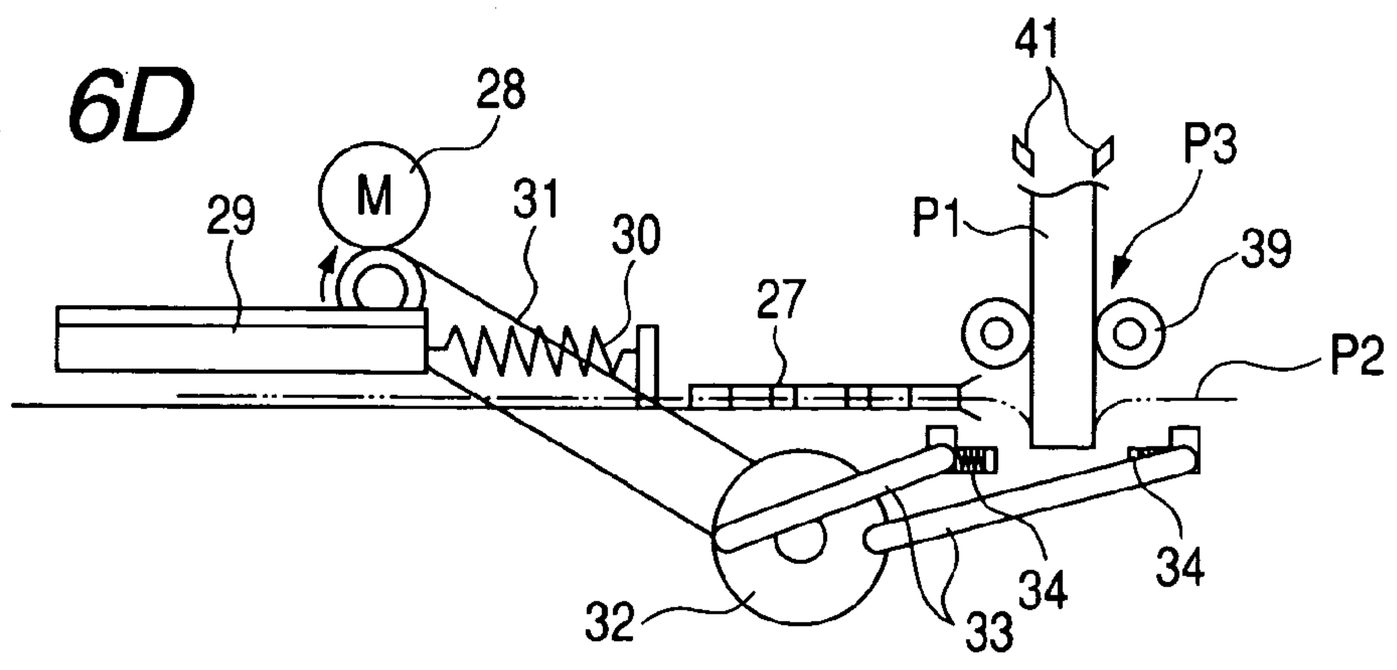


FIG. 7

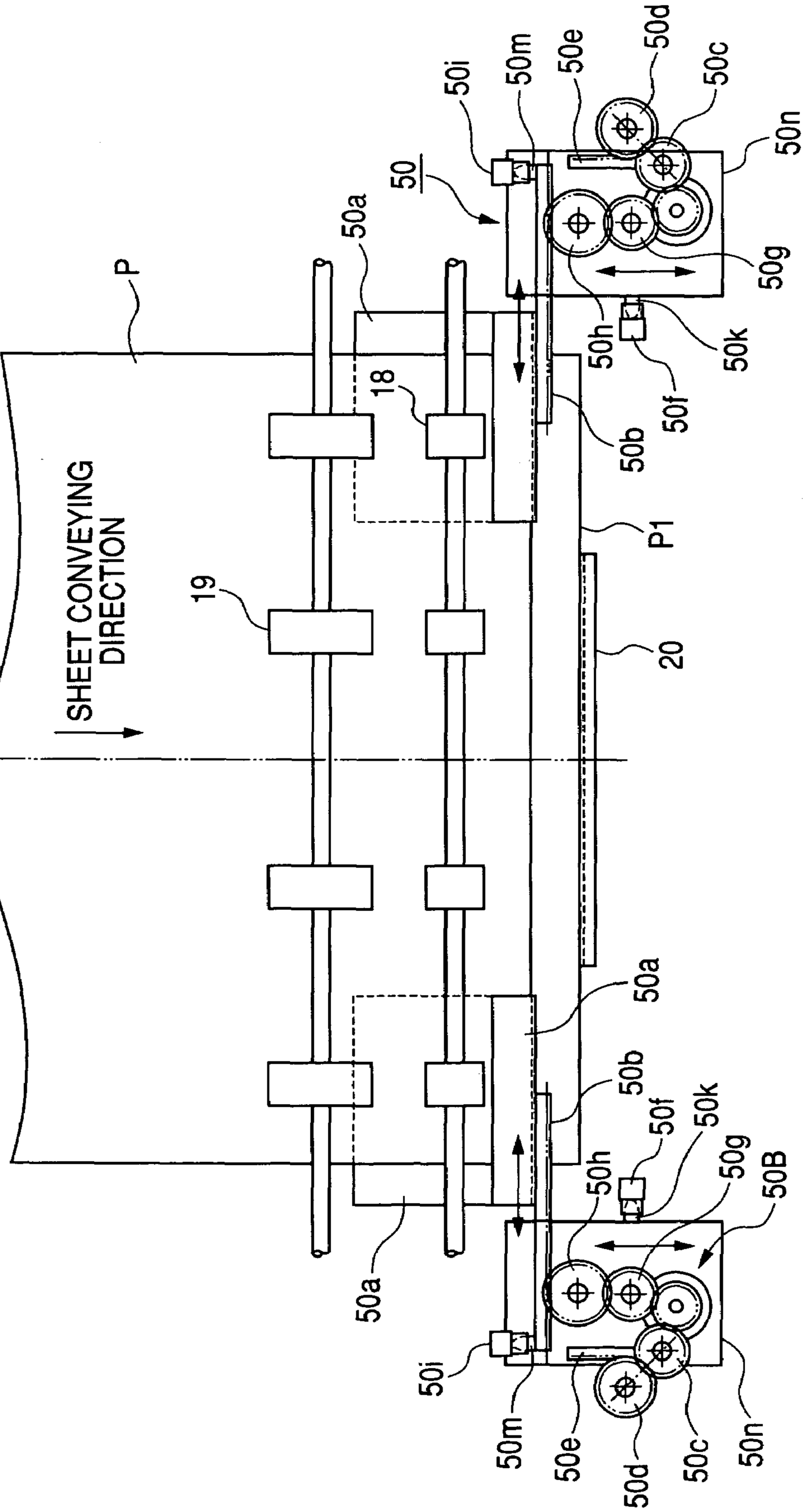

P
SHEET CONVEYING DIRECTION
18
19
20
50
50a
50b
50c
50d
50e
50f
50g
50h
50i
50k
50m
50n
P1
50B

FIG. 8A

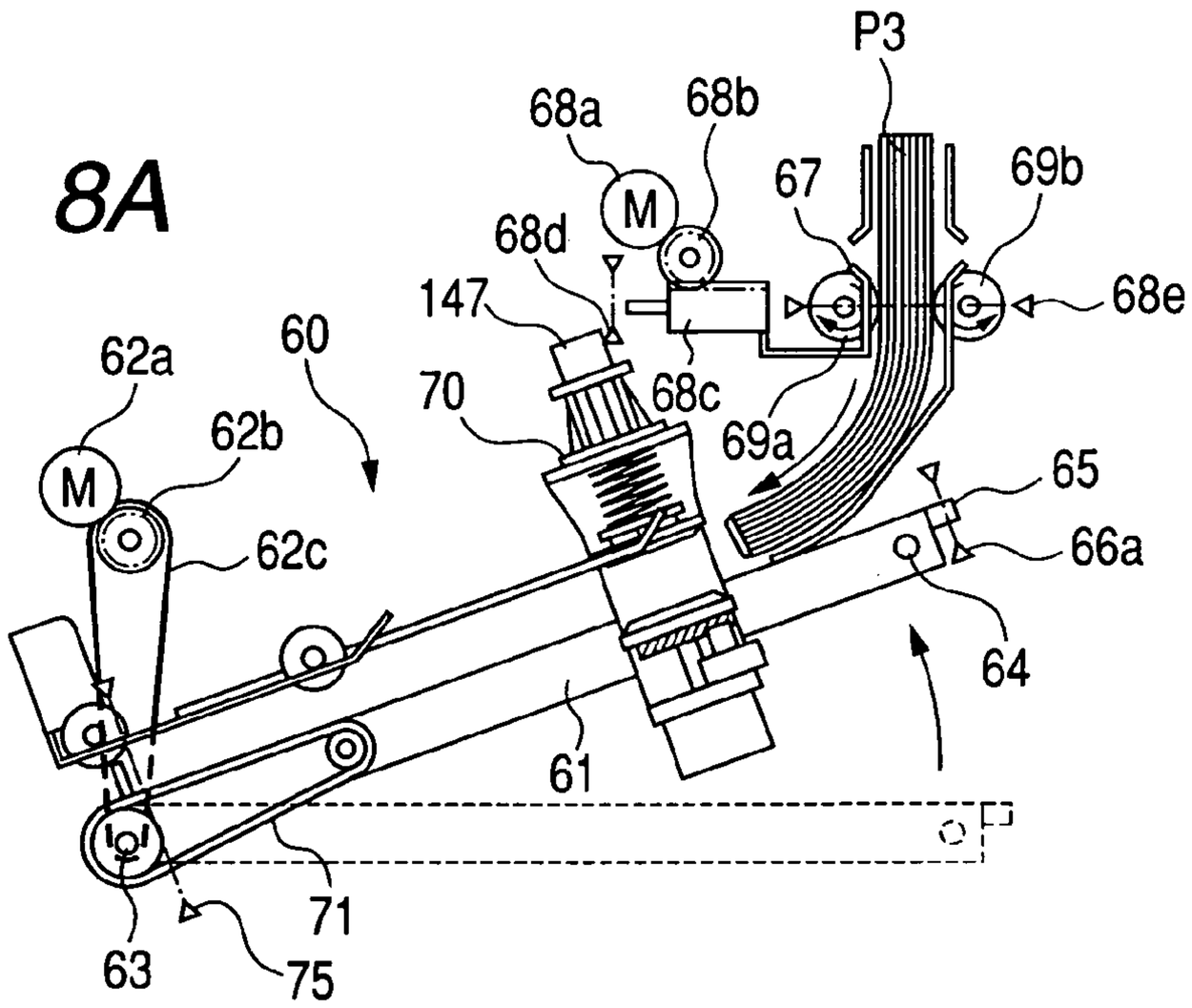


FIG. 8B

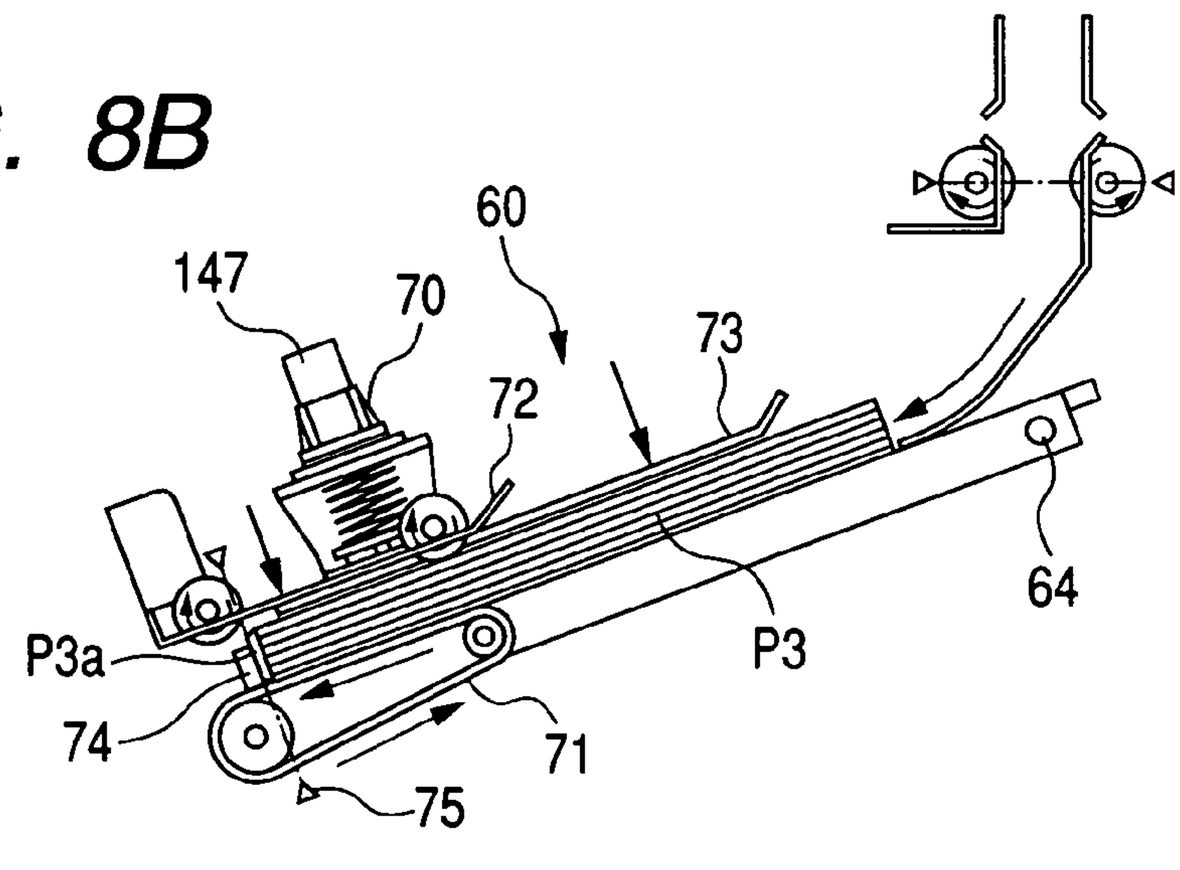


FIG. 8C

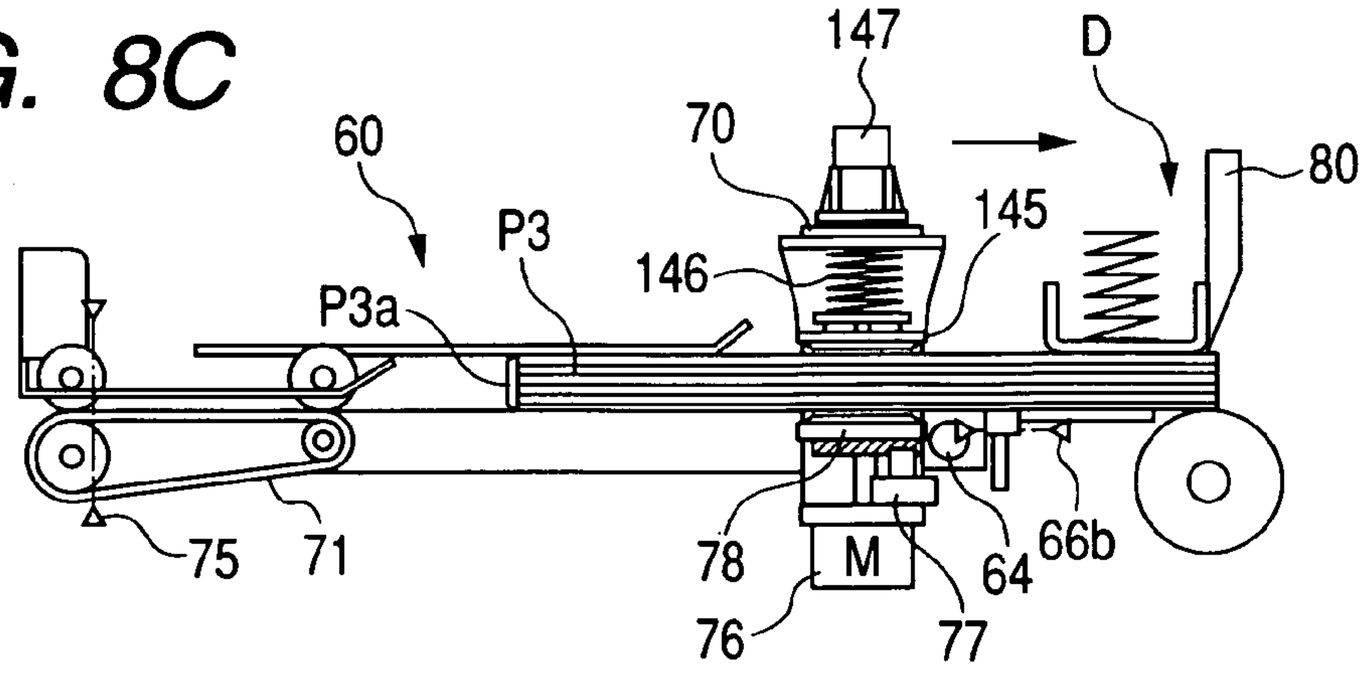


FIG. 9

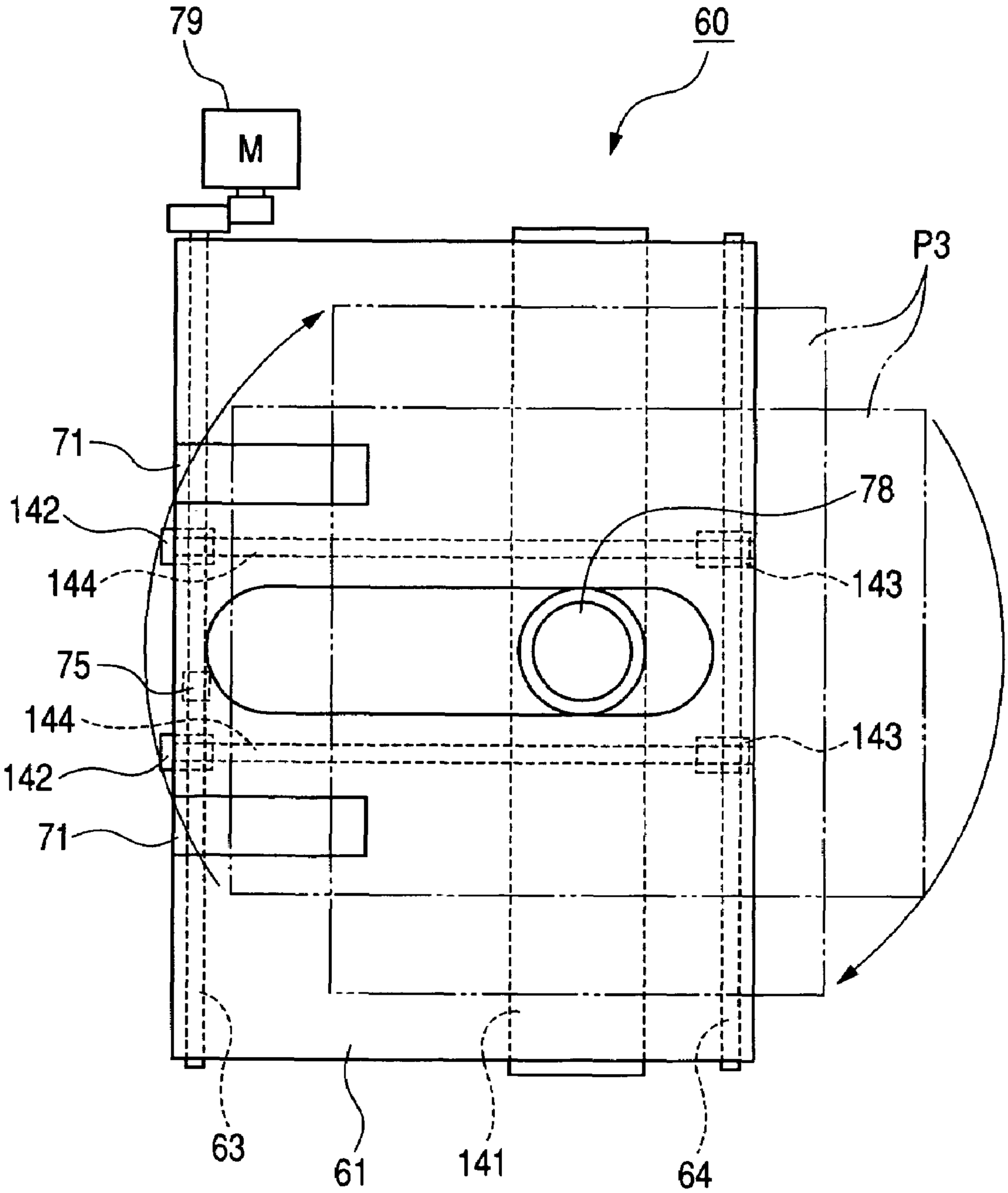
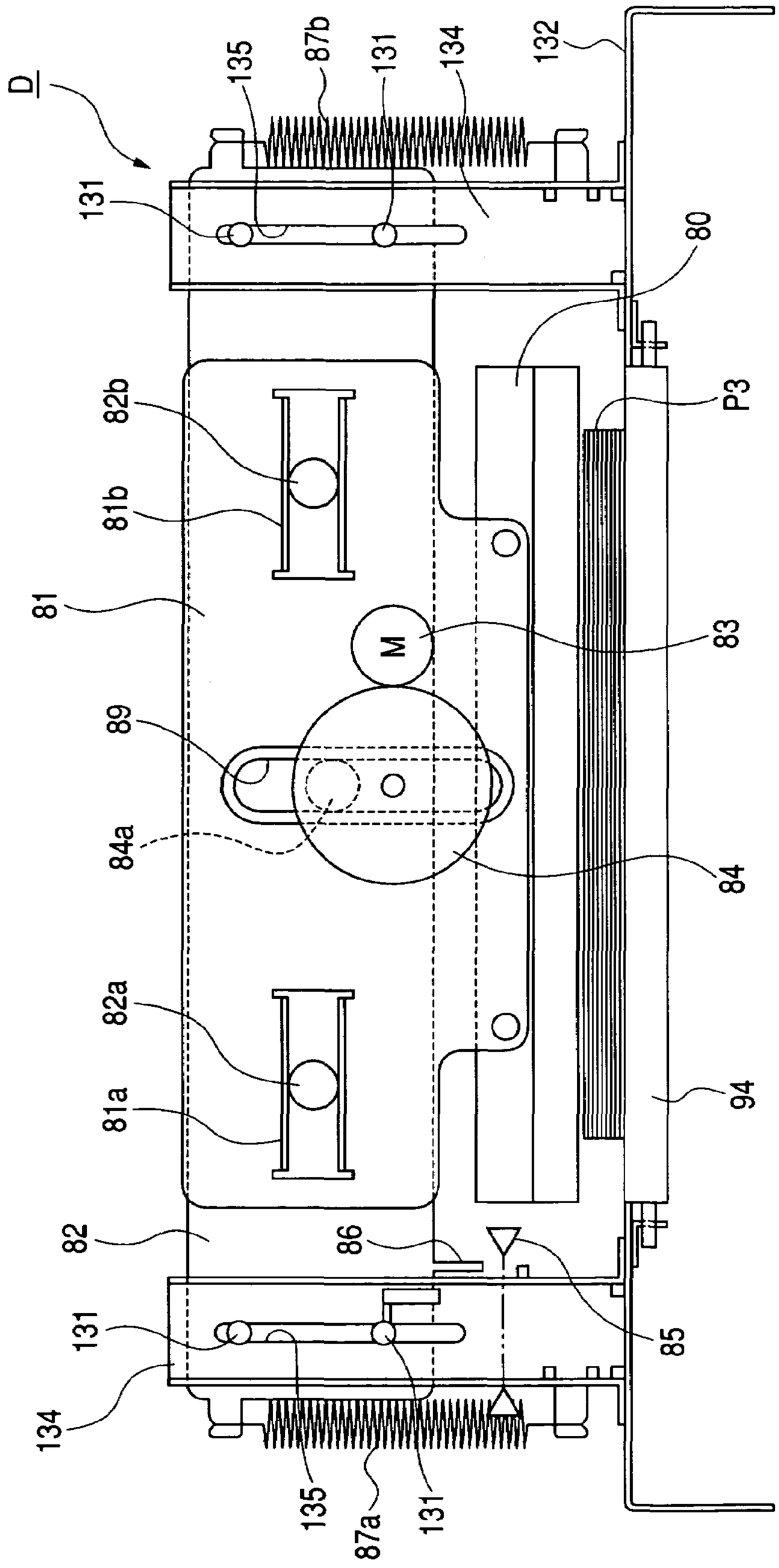


FIG. 10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134
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131
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82b
P3
81b
81
M
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82a
81a
94
82
86
85
131
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135
87a
131

FIG. 11B

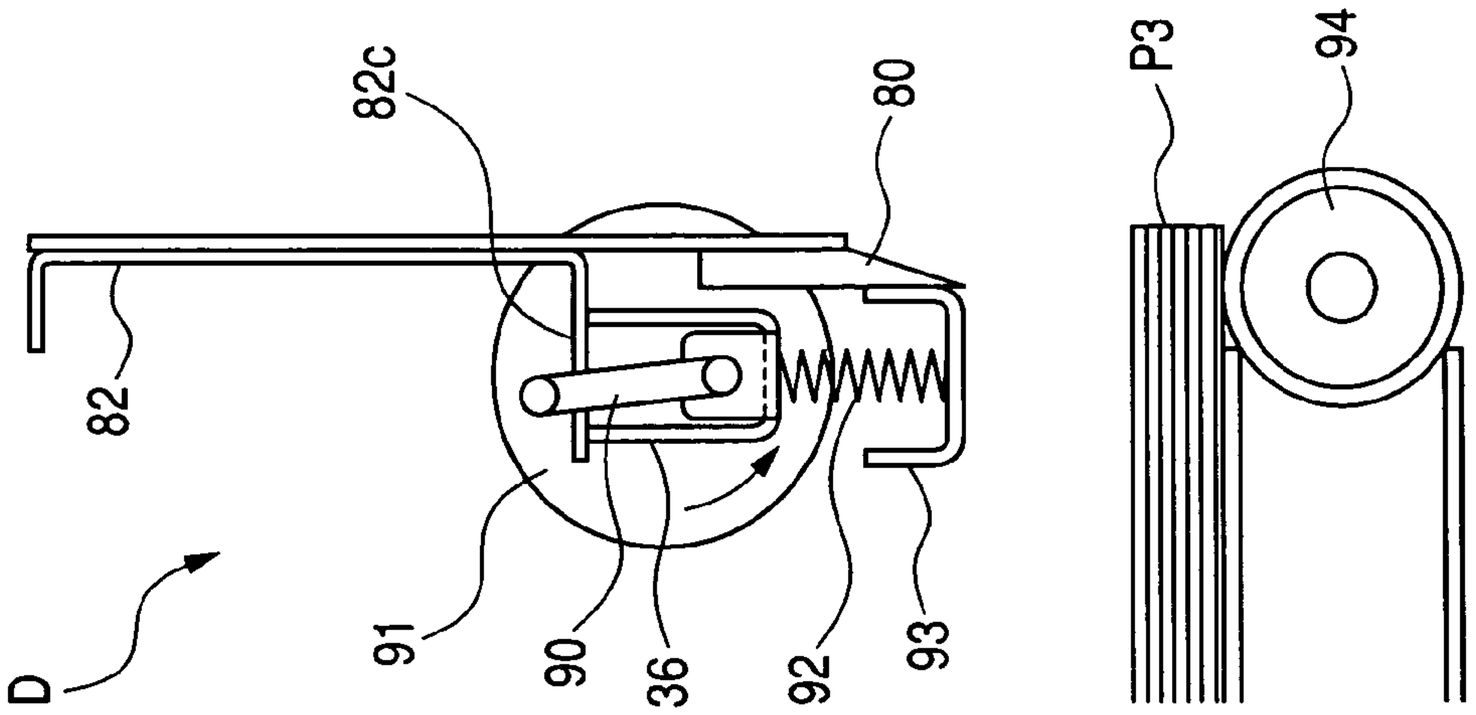


FIG. 11A

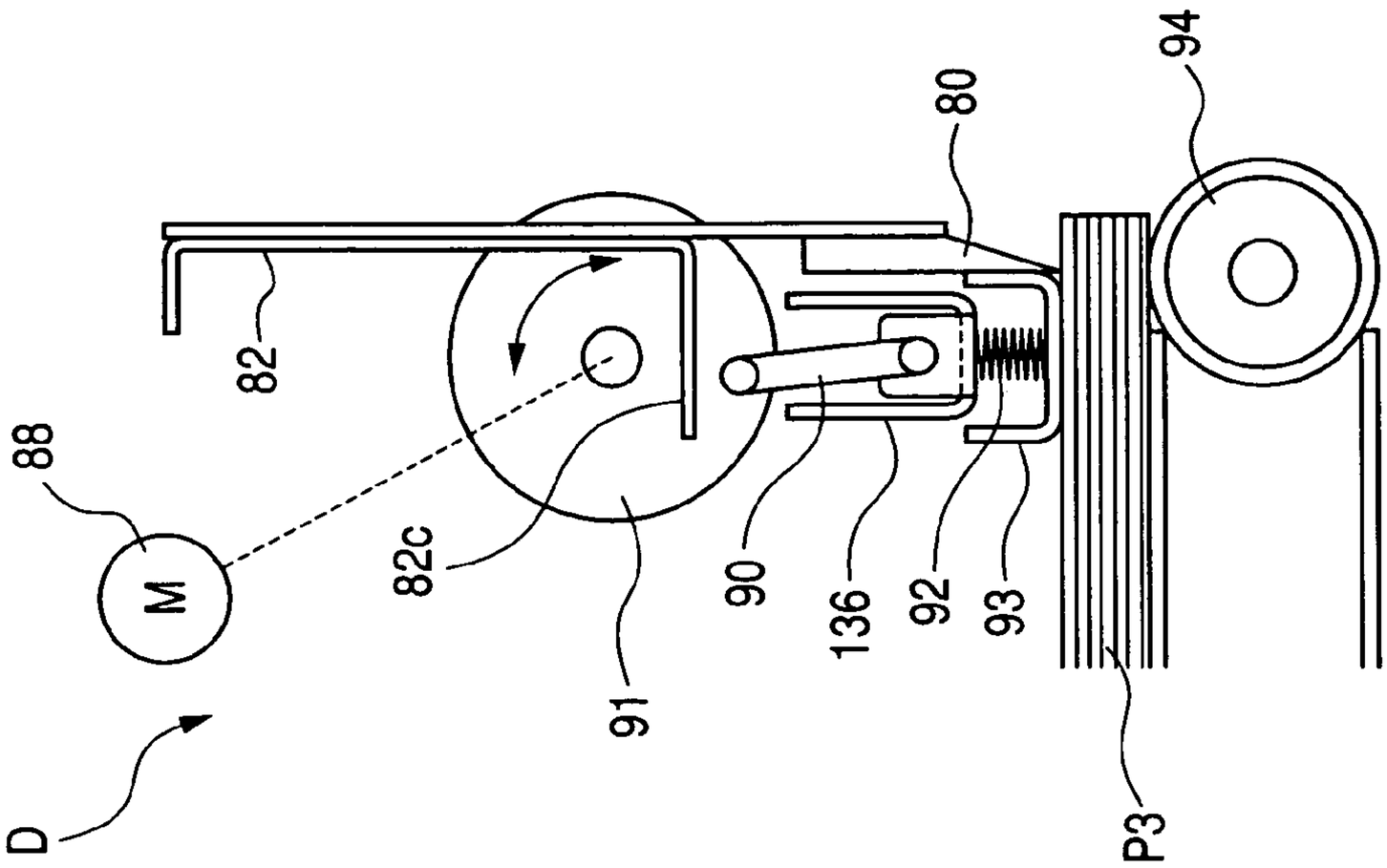


FIG. 12

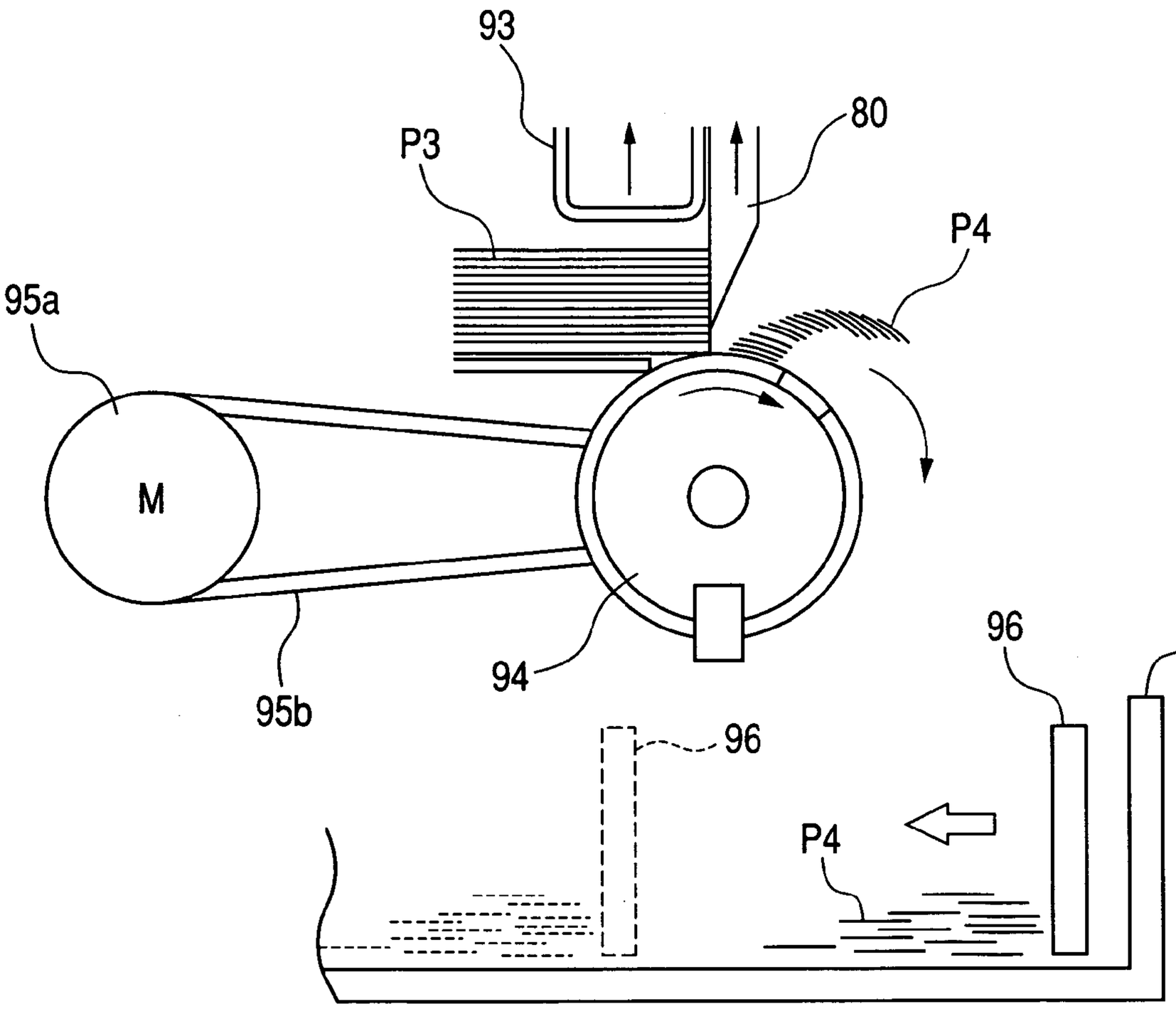


FIG. 13

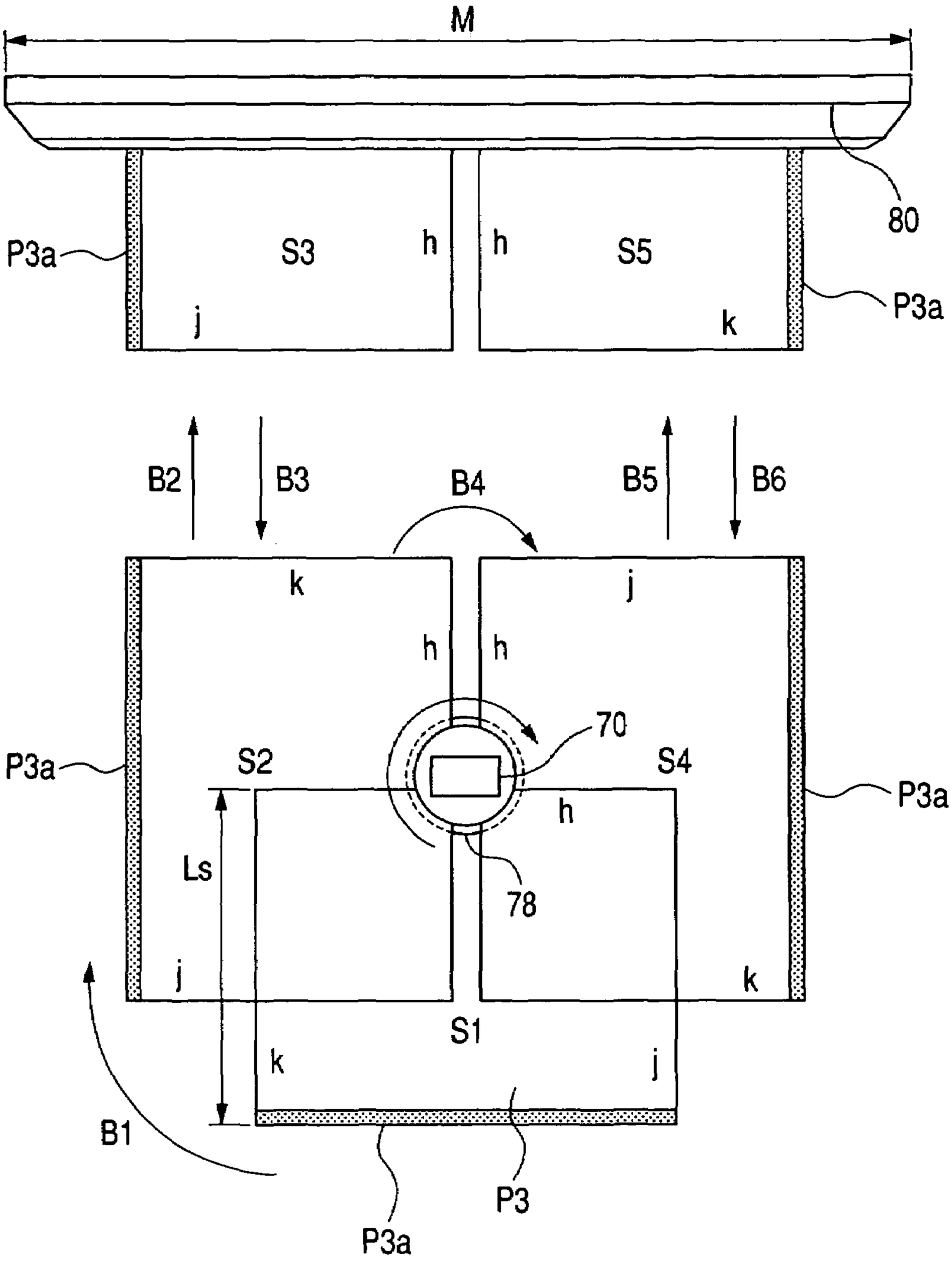

M
80
P3a
S3
h
h
S5
P3a
j
k
B2
B3
B4
B5
B6
k
j
h
h
70
P3a
S2
S4
P3a
h
Ls
78
j
k
S1
k
j
B1
P3
P3a

FIG. 14

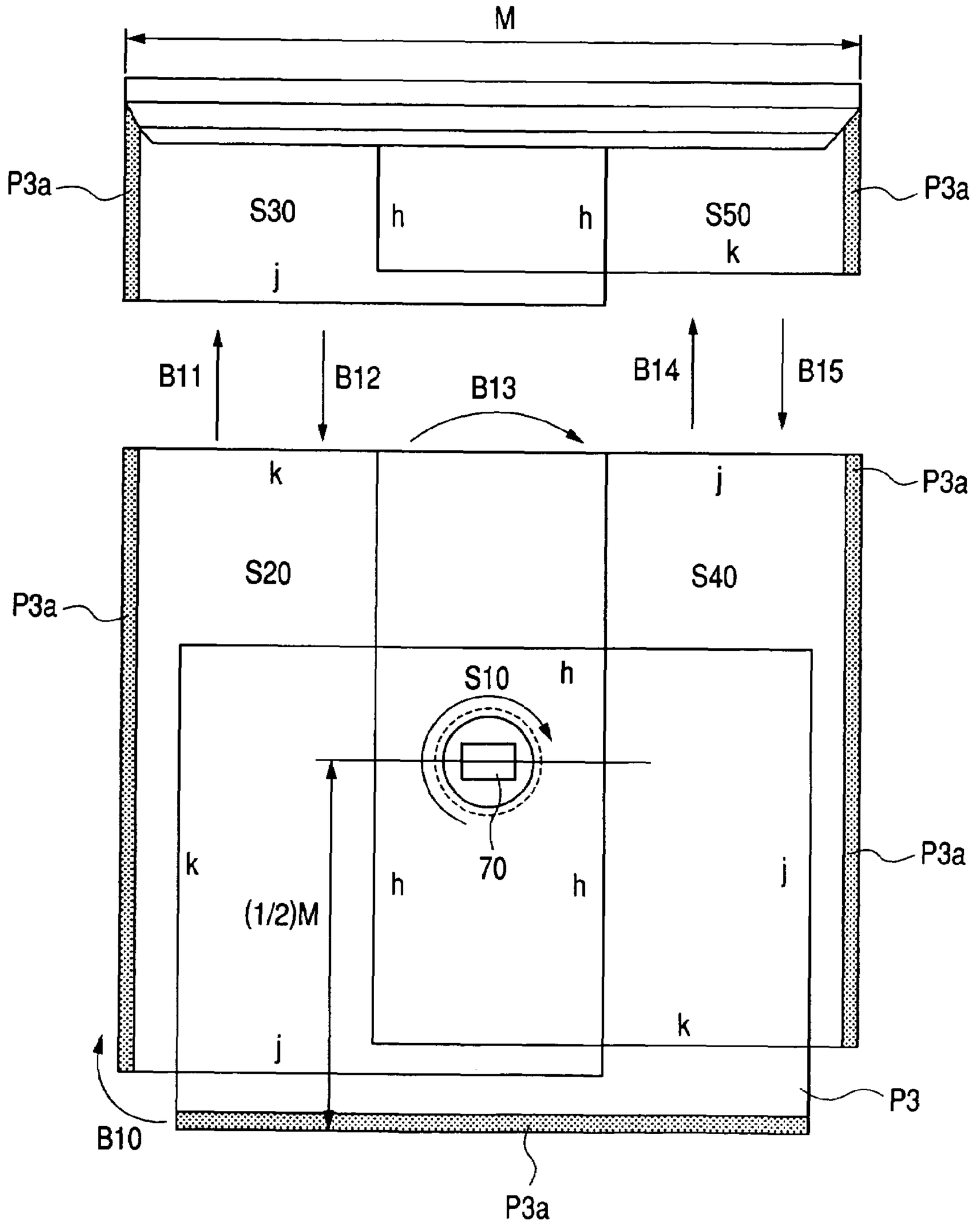
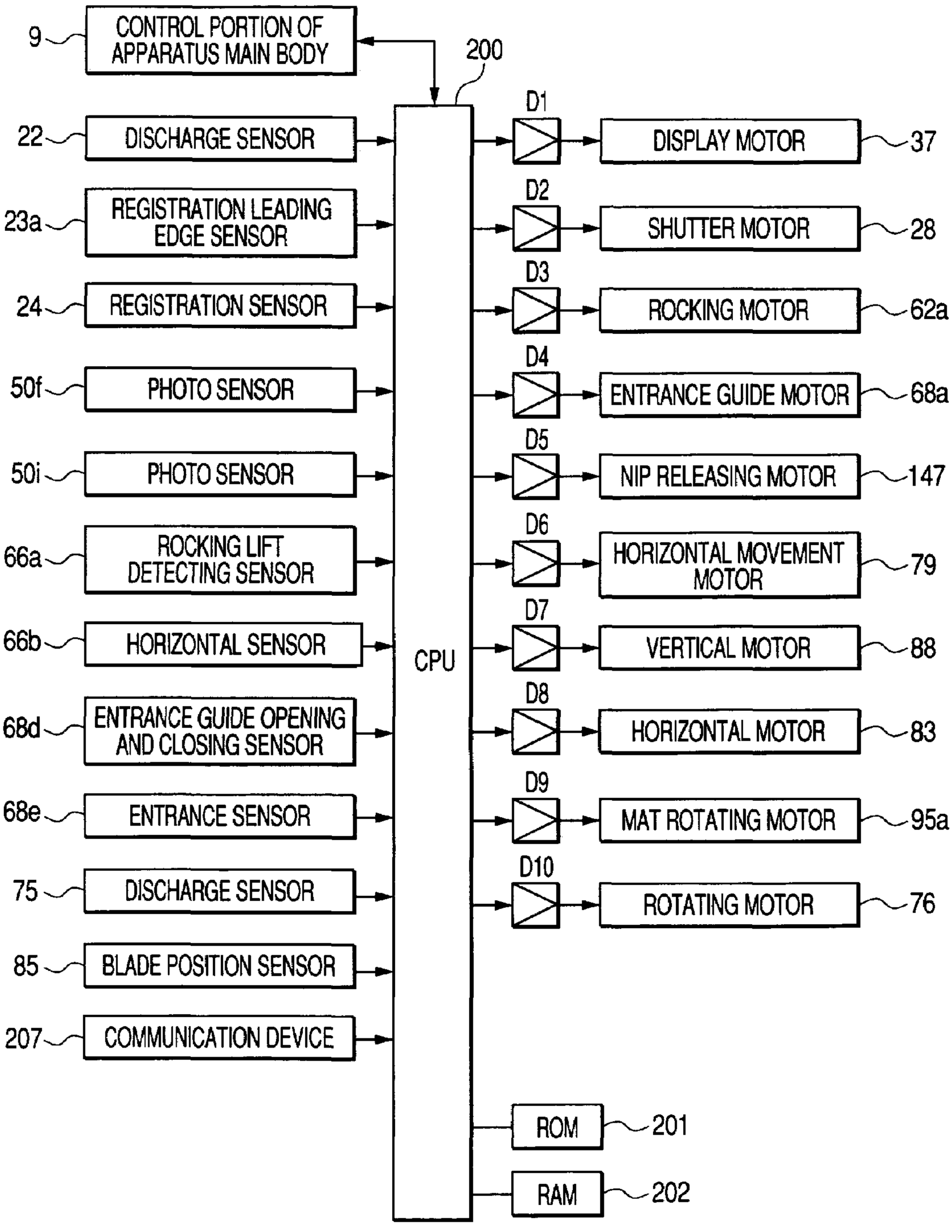

M
P3a
S30
h
h
S50
k
j
P3a
B11
B12
B13
B14
B15
k
j
P3a
S20
S40
P3a
S10
h
70
h
h
j
P3a
k
(1/2)M
j
k
P3
B10
P3a

FIG. 15


9
CONTROL PORTION OF APPARATUS MAIN BODY
200
22
DISCHARGE SENSOR
23a
REGISTRATION LEADING EDGE SENSOR
24
REGISTRATION SENSOR
50f
PHOTO SENSOR
50i
PHOTO SENSOR
66a
ROCKING LIFT DETECTING SENSOR
66b
HORIZONTAL SENSOR
68d
ENTRANCE GUIDE OPENING AND CLOSING SENSOR
68e
ENTRANCE SENSOR
75
DISCHARGE SENSOR
85
BLADE POSITION SENSOR
207
COMMUNICATION DEVICE
CPU
D1
DISPLAY MOTOR
37
D2
SHUTTER MOTOR
28
D3
ROCKING MOTOR
62a
D4
ENTRANCE GUIDE MOTOR
68a
D5
NIP RELEASING MOTOR
147
D6
HORIZONTAL MOVEMENT MOTOR
79
D7
VERTICAL MOTOR
88
D8
HORIZONTAL MOTOR
83
D9
MAT ROTATING MOTOR
95a
D10
ROTATING MOTOR
76
ROM
201
RAM
202

SHEET CUTTING APPARATUS, SHEET AFTERTREATMENT APPARATUS HAVING THE SAME, AND IMAGE FORMING APPARATUS HAVING THE SAME

This application claims priority benefits of Japanese Patent Application No. 2004-088005 filed Mar. 24, 2004, the entire disclosure of which is hereby incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a sheet cutting apparatus in which a portion of a cutting blade to be used for cutting a sheet, a sheet stack, etc. is varied to make it possible to uniformly use the cutting blade, a sheet aftertreatment apparatus equipped with the sheet cutting apparatus, and an image forming apparatus whose apparatus main body has the sheet aftertreatment apparatus as one of its components.

2. Related Background Art

Conventionally, a sheet cutting apparatus which cuts a sheet, a sheet stack, etc. (hereinafter referred to as "sheets to be cut") with a cutting blade is provided in a sheet aftertreatment apparatus as one of the components of the sheet aftertreatment apparatus which is provided in the apparatus main body of an image forming apparatus. The sheet aftertreatment apparatus binds sheets discharged from the apparatus main body of the image forming apparatus into a stack, and then performs glue binding or saddle-stitch/buckle binding. To align the end surface of the bound sheets, an end portion of the sheet stack is cut off by the sheet cutting apparatus (Japanese Patent Application Laid-open No. 2003-292230). The sheet cutting apparatus may cut not only a sheet stack but also a single sheet. In other words, the sheet cutting apparatus is adapted to cut different forms of sheets to be cut, which may be a sheet stack or a single sheet. The image forming apparatus is an apparatus for forming an image on a sheet, and may be a copying machine, a printer, a facsimile apparatus, a multifunctional apparatus composed of those apparatuses, etc.

In the conventional sheet cutting apparatus, regardless of the size of the sheets to be cut, sheets are always fed to the same position and cut there. Thus, the cutting blade is not uniformly used over its entire length but includes a portion always used for cutting regardless of the size of the sheets to be cut, and a portion not used for cutting according to the size of the sheets to be cut, resulting in a variation in wear. As a result, when its portion constantly used has lost its sharpness, the cutting blade must be replaced by a new one even if it includes a portion which is not much used and, consequently, cuts well. Thus, the cutting blade cannot be used for a long period of time.

Further, the sheet aftertreatment apparatus equipped with the sheet cutting apparatus requires temporary suspension of after-treatment operation in order to replace the cutting blade, resulting in a rather low operating efficiency (availability ratio).

Furthermore, due to the low operating efficiency (availability ratio) of the sheet aftertreatment apparatus, the conventional image forming apparatus equipped with the sheet aftertreatment apparatus having such a sheet cutting apparatus exhibits a rather low operating efficiency (availability ratio).

SUMMARY OF THE INVENTION

An object of the present invention is to provide a sheet cutting apparatus which allows uniform use of the cutting blade to thereby reduce the number of times for replacing the cutting blade.

Another object of the present invention is to provide a sheet aftertreatment apparatus equipped with a sheet cutting apparatus in which the number of times for replacing the cutting blade has been reduced, thereby achieving an enhanced operating efficiency (availability ratio).

Still another object of the present invention is to provide an image forming apparatus improved in terms of productivity in image formation through provision of a sheet aftertreatment apparatus with an enhanced operating efficiency (availability ratio).

A sheet cutting apparatus according to the present invention includes: a cutting blade for cutting a sheet to be cut which includes a sheet and a sheet stack; and a transport means capable of holding and rotating the sheet to be cut to cause an end portion of the sheet to be cut to be opposed to the cutting blade and transporting the sheet to be cut to a position where the end portion is cut by the cutting blade.

The transport means is capable of selectively holding, based on the size of the sheet to be cut, a portion of the sheet to be cut which is a central position of the sheet to be cut with respect to a direction crossing a direction in which the sheet to be cut is conveyed and which is an arbitrary position of the sheet to be cut along the conveying direction.

A sheet aftertreatment apparatus according to the present invention includes: an alignment means for aligning an end portion of at least one side of a sheet stack; and the sheet cutting apparatus for cutting the sheet stack aligned by the alignment means.

A sheet aftertreatment apparatus according to the present invention may include: the sheet cutting apparatus; and a supply means for supplying the sheet to be cut to the transport means, with a central position of the sheet to be cut with respect to a direction crossing a direction in which the sheet to be cut is supplied being matched with a central position of the sheet to be cut with respect to a direction crossing a direction in which the sheet to be cut is conveyed in the transport means of the sheet cutting apparatus.

An image forming apparatus according to the present invention includes: an image forming means for forming an image on a sheet; and any one of the sheet aftertreatment apparatuses for cutting a sheet to be cut on which an image has been formed by the image forming means.

These and other objects, features and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic front sectional view of a copying machine constituting an example of an image forming apparatus whose apparatus main body is equipped with a sheet aftertreatment apparatus according to an embodiment of the present invention;

FIG. **2** is a sectional view of the sheet aftertreatment apparatus according to the present invention;

FIG. **3**A is a schematic general front view of the conveyance/alignment unit in the sheet aftertreatment apparatus of FIG. **2**;

FIG. **3**B is an enlarged front view of the buffer mechanism;

FIG. **4** is a diagram showing a registration roller pair as seen from the right-hand side in FIG. **2**;

FIG. **5** is a schematic plan view of a gluing unit;

FIGS. **6**A, **6**B, **6**C, and **6**D are diagrams for illustrating a binding process of attaching a cover sheet to a glued sheet stack, in which: FIG. **6**A is a diagram showing a state where the operation of attaching the cover sheet to the glued sheet stack is started; FIG. **6**B is a diagram showing a state where a cover attaching path is opened and the glued sheet stack starts to descend; FIG. **6**C is a diagram showing a state where the cover sheet is attached to the glued sheet stack; and FIG. **6**D is a diagram showing a state where the attachment of the cover sheet to the glued sheet stack has been completed;

FIG. **7** is a side view of a buffer mechanism of an alignment longitudinal path;

FIGS. **8**A, **8**B, and **8**C are explanatory front views for illustrating the operation of a rotation stage, in which: FIG. **8**A is a diagram showing a state where a bound sheet stack starts to be fed from a conveyance/alignment unit; FIG. **8**B is a diagram showing in a state where the bound sheet stack is received from the conveyance/alignment unit; and FIG. **8**C is a diagram showing a state where the sheet stack is conveyed from the rotation stage to a cutting blade;

FIG. **9** is a plan view of the rotation stage;

FIG. **10** is a side view of a trimmer unit;

FIGS. **11**A and **11**B are diagrams for illustrating the operation of a sheet stack presser, in which: FIG. **11**A is a diagram showing a state where the sheet stack presser pressurizes a bound sheet stack and the cutting blade starts to cut the bound sheet stack; and FIG. **11**B is a diagram showing a state where the sheet stack presser and the cutting blade are detached from the bound sheet stack;

FIG. **12** is a diagram for illustrating the operation of dropping cut sheet dust in front of a pusher through rotation of a mat and discharging it into a dust box;

FIG. **13** is a plan view for illustrating a cutting order in which a bound sheet stack whose shorter side has a length not more than half of the length of the cutting blade is cut by the rotation stage and the trimmer unit;

FIG. **14** is a plan view for illustrating a cutting order in which a bound sheet stack whose shorter side has a length more than half of the length of the cutting blade is cut by the rotation stage and the trimmer unit; and

FIG. **15** is a control block diagrams for a sheet aftertreatment apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A sheet cutting apparatus according to an embodiment of the present invention, a sheet aftertreatment apparatus equipped with this sheet cutting apparatus, and copying machine constituting an example of an image forming apparatus whose apparatus main body has this sheet aftertreatment apparatus as one of its components, will be described with reference to the drawings. The values mentioned in the description of this embodiment are only given for reference purposes, and should not be construed restrictively.

The image forming apparatus may be a copying machine, a printer, a facsimile apparatus, a multifunctional apparatus composed of these apparatuses, etc. That is, the image forming apparatus is not restricted to a copying machine. Further, the sheet aftertreatment apparatus is not always provided in the apparatus main body of a copying machine. It may also be provided in the apparatus main body of a printer, a facsimile apparatus, a multifunctional apparatus composed of those apparatuses, etc.

As shown in FIG. **1**, a copying machine G according to this embodiment is composed of an apparatus main body A, and a sheet aftertreatment apparatus B having a trimmer unit D. It is also possible for the apparatus main body A and the sheet aftertreatment apparatus B to be used separately.

Further, while in FIG. **1** the sheet aftertreatment apparatus B is provided by the side of the apparatus main body A of the copying machine G as one of the components of the copying machine G, it may also be incorporated into the apparatus main body A.

Further, the apparatus main body A of the copying machine is provided with a control portion **9** for controlling the apparatus main body A, and the sheet aftertreatment apparatus is equipped with a central processing unit (hereinafter referred to as the "CPU") **200** which performs transmission and reception of data, control signals, etc. to and from the control portion **9** of the apparatus main body A to control the sheet aftertreatment apparatus. It is also possible to integrate the control portion **9** and the CPU **200** with each other and to provide the resultant integrated control portion in one of the apparatus main body A and the sheet aftertreatment apparatus to thereby control the apparatus main body A and the sheet aftertreatment apparatus.

While in the sheet aftertreatment apparatus of this embodiment the sheets are stacked together and then glued to be bound, it is also possible to effect saddle-stitch/buckle binding on the sheets after stacking them together. Further, it is also possible to effect staple binding with a stapler.

While the sheet cutting apparatus of this embodiment cuts a glue-bound sheet stack, it can also cut a saddle-stitch/buckle-bound sheet stack or an unbound sheet stack.

Further, the sheet cutting apparatus of this embodiment can cut not only a sheet stack but also a single sheet. That is, the sheet cutting apparatus of this embodiment can cut sheets to be cut in the form of a single sheet, a sheet stack, etc. In the following, the case in which a sheet stack is cut will be described.

(General Construction of the Copying Machine)

FIG. **1** is a schematic front sectional view of a copying machine constituting an example of an image forming apparatus whose apparatus main body is equipped with a sheet aftertreatment apparatus having a sheet cutting apparatus according to an embodiment of the present invention. The apparatus main body A of the copying machine G optically reads an original automatically fed from an original feeding device **1** provided in the upper portion of the apparatus at a scanner portion **2**, and transmits as a digital signal the information thus obtained to the image forming means such as an image forming portion **3**, thus recording the information on a sheet such as an ordinary paper sheet or an OHP sheet.

In the lower portion of the apparatus main body A of the copying machine G, a plurality of sheet cassettes **4** accommodating sheets of various sizes are provided such that they can be drawn out (FIG. **1** only shows one of them, omitting the others). A sheet conveyed from the sheet cassettes **4** by conveying rollers **5** undergoes an image recording using an electrophotographic method at the image forming portion **3**.

That is, based on the information read at the scanner portion **2**, the apparatus main body A applies a laser beam from a light emitting portion **3***a* to a photosensitive drum **3***b* to form a latent image, which is developed with toner and transferred to the sheet. Thereafter, the apparatus main body A conveys the sheet to a fixing portion **6**, where the toner image is permanently fixed to the sheet by heating and pressurization. Then, in a one-side recording mode in which a toner image is formed on one side of a sheet, the apparatus main body A sends the sheet as it is to the sheet aftertreatment apparatus B.

In a two-side recording mode in which toner images are formed on both sides of a sheet, the apparatus main body A effects switch back conveyance on the sheet with the image recorded on one side thereof and reverses it before conveying it to a re-conveyance path **7**. Then, the apparatus main body A conveys the sheet to the image forming portion **3** again to form an image also on the other side of the sheet before sending it to the sheet aftertreatment apparatus B. Before sending the sheet to the sheet aftertreatment apparatus B, the apparatus main body A supplies the sheet aftertreatment apparatus B with a signal indicating the sheet size, etc., causing the sheet aftertreatment apparatus B to previously perform path switching therein, etc.

Apart from the feeding from the sheet cassette **4**, the sheet can also be fed manually from a multiple tray **8**.

As shown in FIG. **2**, the sheet aftertreatment apparatus B is composed, for example, of a conveyance/alignment unit C serving as a supply means, and a trimmer unit D. Apart from the operation of the ordinary discharge mode, the sheet aftertreatment apparatus B can selectively conduct glue-binding and cutting; it can cut the three sides of a sheet stack other than the glued side. It is not always necessary for the sheet aftertreatment apparatus B to be provided with the conveyance/alignment unit C. It is also possible for the aftertreatment apparatus B to be solely capable of cutting sheet stacks. Further, it is not always necessary for the trimmer unit D to cut the three sides of a sheet stack. It may also cut one side only.

In the normal mode, a sheet P discharged from the apparatus main body A of the copying machine G to the sheet aftertreatment apparatus B is conveyed by conveying roller pairs **10***a*, **10***b*, **10***c*, and **10***d*, and discharged onto a stack tray **11**. In the glue-binding mode, the sheet P undergoes a predetermined treatment described below, and is discharged onto a stacking tray E.

(Control Portion of the Sheet Aftertreatment Apparatus)

FIG. **15** shows the control system for the sheet aftertreatment apparatus B. In FIG. **15**, as the control means of this embodiment, there are electrically connected to the input side of the CPU **200** a discharge sensor **22** for detecting a sheet fed to an alignment longitudinal path **35** (see FIG. **2**); a registration leading edge sensor **23***a* for detecting whether the sheet has been sent to a registration roller pair **23** or not; a registration sensor **24** (see FIG. **4**) for detecting movement of the sheet in a direction crossing the sheet conveying direction; photo sensors **50***f* (see FIG. **7**) for detecting movement of moving members **50***n*; photo sensors **50***i* for detecting movement of reception tables **50***a* and racks **50***b*; a rocking lift detecting sensor **66***a* (see FIG. **8**A) for detecting upward rotation of a rocking unit **61**; a horizontal sensor **66***b* for detecting downward rotation of the rocking unit **61**; an entrance guide opening and closing sensor **68***d* for detecting movement of an entrance guide **67**; an entrance sensor **68***e* for detecting a sheet fed to the entrance guide **67**; a discharge sensor **75** for detecting a sheet discharged from a rotation stage **60**; a blade position sensor **85** for detecting the position of a cutting blade **80**; a communication device **207** for transmitting sheet size data designated by the user to the CPU **200**, and the like.

Electrically connected to the output side of the CPU **200** through drivers D**1**, D**2**, D**3**, D**4**, D**5**, D**6**, D**7**, D**8**, D**9**, and D**10** are respectives of a cover motor **37** (see FIG. **4**) for moving a cover sheet P**2**, a shutter motor **28** for operating creasing tables **34** (see FIGS. **6**A through **6**D), a rocking motor **62***a* for rotating a rocking unit **61** (see FIGS. **8**A, **8**B and **8**C), an entrance guide motor **68** for moving an entrance guide **67** (see FIG. **8**A), a nip releasing motor **147** for releasing the nipping of a bound sheet stack by a gripper unit **70**, a horizontal movement motor **79** (see FIG. **9**) for moving the gripper unit **70**, a vertical motor **88** (see FIG. **11**A) for raising and lowering a sheet presser **93**, a horizontal motor **83** (see FIG. **10**) for moving the cutting blade **80** in a direction parallel to the sheet surface, a mat rotating motor **95***a* for rotating a mat **94** (see FIG. **12**), a rotating motor **76** for rotating a rotation guide gear **78** (see FIG. **8**C), a plunger (not shown), etc.

Further, as storage portions, the CPU **200** has, for example, a read only memory (ROM) **201** and a random access memory (RAM) **202**. The ROM **201** stores, for example, a control program corresponding to cutting control procedures (described later) for bound sheet stacks of different sizes to be executed by the CPU **200**. The RAM **202** is a portion that temporarily stores information such as computation data of the CPU **200** and a sheet size inputted by the user.

When signals from the above-mentioned respective sensors and the ROM **201** and the RAM **202** are input thereto, the CPU **200** executes the control program based on the signals, controlling the respective motors, plunger (not shown), etc. so cutting control, etc. can be executed. Further, signals are transmitted and received between the CPU **200** and the control portion **9** in the apparatus main body A of the copying machine G to thereby control the sheet aftertreatment apparatus B as a whole.

(Stacking on the Alignment Longitudinal Path)

In the binding mode, the sheet P discharged from the apparatus main body A is guided by a first flapper **12** and a second flapper **13** shown in FIGS. **2**, **3**A and **3**B to be fed to a sheet binding path **14**. The first flapper **12** effects switching between a non-sorting path **15** and a cover path **16**. The second flapper **13** effects switching between the sheet binding path **14** and the cover path **16**.

The sheet P conveyed by the conveying roller pairs **10***a*, **17***a*, and **17***b* is discharged into the alignment longitudinal path **35** by a discharge roller pair **18**, and then returned by a semicircular roller **19** and the discharge roller pair **18** to a position where the trailing edge of the sheet P abuts a trailing-edge stopper **20** to effect alignment in the sheet conveying direction (trailing edge alignment). Then, the sheet P is pushed-in in the direction of the sheet center by, for example, an alignment plate **21** serving as an alignment means, and alignment in a direction crossing the sheet conveying direction is effected. That is, the sheet P is pushed-in in the direction of the center with respect to the sheet width direction (the direction crossing the sheet conveying direction), and the side ends of the sheet are aligned.

When the trailing edge of the sheet P passes the discharge roller pair **18**, the discharge roller pair **18** is controlled so as to be reduced in rotating speed. As a result, the sheet P discharged into the alignment longitudinal path **35** is reliably fed to the alignment longitudinal path **35** by the rotation of the semicircular roller **19**, thus reliably effecting trailing edge alignment.

When a predetermined period of time has elapsed after the passing of the trailing edge of the sheet through the discharge sensor **22**, or when the motor RPM has attained a predetermined RPM, the sheet is regarded to have passed the discharge roller pair **18**.

(Semicircular Roller)

Next, the semicircular roller **19**, which pulls back the sheet P discharged into the alignment longitudinal path **35** in a direction opposite to the discharging direction, will be described.

As shown in FIG. **3**B, the semicircular roller **19** is cut out into a semicircular configuration. Normally, the cutout portion of the semicircular roller **19** is situated on the alignment

longitudinal path **35** side, so that the semicircular roller **19** does not hinder the discharge of the sheet P discharged from the discharge roller pair **18**. Each time one sheet P is discharged into the alignment longitudinal path **35**, the semicircular roller **19** rotates in a direction opposite to the sheet discharging direction of the discharge roller pair **18**, and comes into contact with the trailing edge of the sheet P in the alignment longitudinal path **35**, pulling back the sheet P by frictional force caused between the semicircular roller **19** and the sheet P. That is, the semicircular roller **19** pulls back the sheet P in a direction where the sheet P falls.

(Alignment Longitudinal Path Plate)

An alignment longitudinal path plate **36** can be moved in a direction indicated by an arrow a in FIGS. **3**A and **3**B by an alignment longitudinal path motor (not shown), making it possible to adjust the path gap of the alignment longitudinal path **35**. In order to maintain substantially at a fixed level a contact pressure of the semicircular roller **19** with respect to the uppermost one of the sheets discharged into the alignment longitudinal path **35**, the alignment longitudinal path plate **36** moves the alignment longitudinal path plate **36** such that the path is widened based on the number of sheets discharged into the alignment longitudinal path **35**.

(Operating Timing of the Semicircular Roller)

The semicircular roller **19** is operated after the discharge roller pair **18** has released the trailing edge of the sheet P. More specifically, the semicircular roller **19** rotates in a direction opposite to the sheet discharging direction after a predetermined period of time has elapsed since the passing of the trailing edge of the sheet P through the discharge sensor **22** provided on the upstream side of the discharge roller pair **18**.

(Cover Path)

The sheet P discharged from the apparatus main body A is guided to the cover path **16** by the first flapper **12** and the second flapper **13**. As shown in FIG. **2** (see FIGS. **3**A and **3**B) and FIG. **4**, halfway through the cover path **16**, there are arranged a registration roller pair **23** and a registration leading edge sensor **23***a* provided on the upstream side of the registration roller pair **23**. At the point in time when the cover sheet P**2** is guided to the cover path **16**, the registration roller pair **23** is at rest. It starts to rotate after a fixed period of time since the abutment of the leading edge of the cover sheet P**2** with the registration roller pair **23**. A judgment as to whether the leading edge of the cover sheet P**2** has come into contact with the registration pair **23** or not is made by checking whether a predetermined time has elapsed after the passing of the cover sheet P**2** through the registration leading edge sensor **23***a* or detecting the motor RPM. By effecting control so as to keep the registration roller pair **23** at rest, a loop is formed at the leading edge of the cover sheet P**2** guided to the cover path **16**, making it possible to effect skew feed correction.

The registration roller pair **23** can be moved in a direction perpendicular to the sheet conveying direction (i.e., a direction crossing the same or the sheet width direction) by the cover motor **37** and a rack **38**. After the trailing edge of the cover sheet P**2** has left the conveying roller pair **17***a*, the registration roller pair **23** moves in the direction indicated by the arrow b in FIG. **4** while nipping and conveying the cover sheet P**2**, and the registration sensor **24** is shielded. Thereafter, the registration roller pair **23** moves in the direction indicated by the arrow c to release the registration sensor **24**, and stops after moving by a fixed amount. The registration sensor **24** is arranged at a sheet end position (side end position) of the sheet stack P**1** in the alignment longitudinal path **35**, so that the cover sheet P**2** in the cover path **16** and the sheet stack P**1** in the alignment longitudinal path **35** move to positions deviated by a fixed amount in a direction perpendicular to the sheet conveying direction (i.e., a direction crossing the same or the width direction of the sheet and the sheet stack). The registration roller pair **23** receives a sheet size signal from the apparatus main body A, and conveys the cover sheet P**2** in the cover path **16** by a predetermined amount based on the sheet size before stopping.

(Gripper)

A gripper **41**, shown in FIGS. **3**A and **3**B and FIGS. **6**A through **6**D, is situated in the lower portion of the alignment longitudinal path **35**, and grips the sheet stack P**1** placed in the alignment longitudinal path **35**, thus guiding it to the cover sheet P**2**.

(Gluing Unit)

FIG. **5** is a schematic plan view of a gluing unit **25**. The gluing unit **25** is composed of a tub **25***a*, a glue roller **25***b*, a glue **25***c*, a tub heater **25***d*, shafts **25***e*, a tub driving portion **25***f*, etc.

The tub **25***a* is adapted to move along the shafts **25***e* in the sheet width direction, which is perpendicular to the sheet conveying direction, by the tub driving portion **25***f* by an amount not less than the sheet width, and has two retracted positions (the upper edge side and the lower edge side in FIG. **5**) outside the sheet width. As the tub **25***a* moves from the first retracted position to the second retracted position, a part of the tub **25***a* pushes a part of a link **26** engaged with a trailing edge stopper **20**, causing the trailing edge stopper **20** to move such that it is retracted from the lower portion of the sheet stack P**1** of FIG. **3**B. The glue roller **25***b* is mounted to the tub **25***a*, and rotates as the tub **25***a* moves.

The tub heater **25***d* is mounted to the outer side of the tub **25***a*. At the start of the binding mode, the-tub heater **25***d* heats the tub **25***a*, and melts the glue **25***c* in the tub **25***a*. Through movement of the tub **25***a* by the tub driving portion **25***f*, the glue roller **25***b* rotates, and the molten glue **25***c* is spread over the entire outer peripheral surface of the glue roller **25***b*.

The sheet stack P**1** placed in the alignment longitudinal path **35** is held by the gripper **41** (see FIG. **3**A), and the tub **25***a* moves from the first retracted position to the second retracted position to cause the trailing edge stopper **20** to be retracted from the lower portion of the sheet stack P**1**, whereby the glue **25***c* is applied to the lower end surface of the sheet stack P**1** by the gluing unit **25**.

(Binding Process)

As shown in FIG. **6**A, a shutter path **27** is situated on the downstream side of the cover path **16** (see FIG. **2**); when the cover sheet P**2** is being conveyed, it keeps a cover attachment path **42** closed.

As shown in FIG. **6**B, during the binding process, a shutter motor **28** drives a shutter rack **29** to move the shutter path **27** and a spring **30** pulling the shutter rack **29** in one direction to positions where the shutter path **27** and the spring **30** open the cover attachment path **42**. After opening the cover attachment path **42**, the shutter path **27** abuts a stopper (not shown) and stops.

The glue **25***c* is applied to the sheet stack P**1** held by the gripper **41** by the gluing unit **25** shown in FIG. **5**. Thereafter, the gripper **41** moves the glued sheet stack P**1** such that the glued sheet stack P**1** is brought into press contact with the cover sheet P**2** on the creasing tables **34**, thereby the sheet stack P**1** is brought into press contact with the cover sheet P**2**.

Next, as shown in FIG. **6**C, when the shutter motor **28** is further driven, a cam **32** is also rotated by the shutter motor **28** through a belt **31**, and the creasing tables **34** are brought close to each other by guide shafts **33**. The creasing tables **34** perform creasing for a fixed period of time, whereby a bound sheet stack P**3** is completed.

In order to cope with a variation in sheet thickness, the creasing tables **34** are provided with a clearance mechanism. Further, as shown in FIG. **6**D, when the cam **32** continues to be rotated, the creasing tables **34** are separated and retracted from each other, whereby the bound sheet stack P**3** is pushed downstream by extrusion rollers **39**, and is conveyed to a stack curvature path **40** (see FIG. **2**).

(Buffer Mechanism)

A buffer mechanism **50** will be described with reference to FIGS. **3**B and **7**. At the time of sheet after-treatment, such as gluing and binding, the buffer mechanism **50** causes the sheet P conveyed from the apparatus main body A of the copying machine G to retract temporarily. Reception tables **50***a* of the buffer mechanism **50** receiving the sheet are adapted to move in the same direction as the sheet conveying direction and in a direction perpendicular thereto (a direction crossing the same or the sheet width direction). In FIG. **7**, the discharge roller pairs **18**, semicircular rollers **19**, racks **50***e*, and photo sensors **50***f* are stationary.

To move the reception tables **50***a* in the same direction as the sheet conveying direction, first, solely electromagnetic clutch gears **50***c* are placed in a torque transmission state, making it possible to transmit the rotation of a motor (not shown) to gears **50***d*. Then, the gears **50***d* roll and rotate on the racks **50***e*, which are stationary. As a result, the respective portions of the buffer mechanism **50** except for the racks **50***e* move integrally in the same direction as the sheet conveying direction. That is, the reception tables **50***a* move in the same direction as the sheet conveying direction. At this time, by the photo sensors **50***f* and protrusions **50***k* on the moving members **50***n* shielding the photo sensors **50***f*, there are conducted detection of the moving position of the buffer mechanism **50** except for the racks **50***e* in the same direction as the sheet conveying direction and movement control based on the position thus detected.

Further, in order to move the reception tables **50***a* in the direction perpendicular to the sheet conveying direction (the direction crossing the same or the sheet width direction), solely electromagnetic clutch gears **50***g* are placed in a torque transmission state in which the rotation of the motor is transmitted to gears **50***h* to thereby move the racks **50***b*. As a result, the reception tables **50***a* are moved in the direction perpendicular to the sheet conveying direction. At this time, by photo sensors **50***i* provided on the moving members **50***n*, and protrusions **50***m* provided at one end of the racks **50***b* shielding the photo sensors **50***i*, there are conducted detection of the moving position of the reception tables **50***a* in the direction perpendicular to the sheet conveying direction and movement control based on the position thus detected. When no buffering is to be effected on the sheet P, the reception tables **50***a* of the buffer mechanism **50** are retracted to home positions outside the width of the sheet P as shown in FIG. **7**, so that the reception tables **50***a* do not hinder the conveyance of the sheet.

The basic operation of the buffer mechanism **50** will be described. As shown in FIG. **3**B, when the sheet stack P**1** is in the alignment longitudinal path **35** in the state in which it is stacked and aligned on the trailing edge stopper **20**, and it has not been discharged from the alignment longitudinal path **35**, the buffer mechanism **50** slides, in order to buffer the sheets P sequentially conveyed from the apparatus main body A, the reception tables **50***a* from the home positions, where they do not hinder the conveyance of the sheets P, to the positions where they receive the sheets P through rotation of the gears **50***h* shown in FIG. **7** and movement of the racks **50***b*.

When the sheet stack P**1** is discharged from the alignment longitudinal path **35** and there is no sheet stack P**1** on the trailing edge stopper **20**, the buffer mechanism **50** causes the reception tables **50***a* to move downstream with respect to the sheet conveying direction and toward the trailing edge stopper **20**. When the trailing edge of the sheet P buffered is supported by the trailing edge stopper **20**, the buffer mechanism **50** stops the movement of the reception tables **50***a*, causing them to retract to the home positions. The buffer mechanism **50** repeats the above operation until the target number of bound stacks is attained.

(Rotation Stage)

Next, the rotation stage **60** will be described with reference to FIGS. **8**A, **8**B, and **8**C. The rotation stage **60** is adapted to rotate the bound sheet stack P**3** to convey it into the trimmer unit D.

As shown in FIG. **8**A, when the rocking motor **62***a* is started, the torque of the rocking motor **62***a* is transmitted to a rocking drive step gear (not shown) from a rocking ascent/descent gear **62***b* through a rocking ascent/descent belt **62***c*, and further, transmitted to a link mechanism (not shown) through a rocking drive belt (not shown) stretched between a rotation shaft **63** and a link shaft **64**, with the rotation shaft **63** constituting the rotation center, whereby the right-hand end, as seen in FIG. **8**A, of the rocking unit **61** in the rotation stage **60** is raised. The rise of the rocking unit **61** is detected through detection of a protrusion **65** of the rocking unit **61** by a rocking lift detecting sensor **66***a*. Upon receiving a signal indicating detection of the protrusion **65** from the rocking lift detecting sensor **66***a*, the CPU **200** stops the rocking motor **62***a*. The rocking unit **61** is on standby at the position shown in FIG. **8**A.

Above the rocking unit **61**, there is arranged an entrance guide **67** constituting the entrance to the trimmer unit D. An entrance guide motor **68***a* is started through control of the CPU **200** to rotate an entrance guide gear **68***b*, thereby moving an entrance rack **68***c* connected to the entrance guide **67**. The entrance guide motor **68***a* further continues its rotation, and when the entrance rack **68***c* is detected by an entrance guide opening and closing sensor **68***d*, its rotation is stopped through control of the CPU **200**, and the opening movement for the entrance guide **67** is stopped. The entrance guide **67** is on standby in the open state.

When the bound sheet stack P**3** bound through the binding process, is sent to the entrance guide **67** from the conveyance/alignment unit C and detected by an entrance sensor **68***e*, the CPU **200** causes the entrance guide motor **68***a* to rotate based on a detection signal from the entrance sensor **68***e*, and brings the entrance guide **67** close to the bound sheet stack P**3**, thus pressing an entrance driven roller **69***a* against the bound sheet stack P**3**. Then, a stack conveying roller **69***b* rotates in the direction indicated by the arrow in FIG. **8**A to send the bound sheet stack P**3** to the rotation stage **60**.

After conveying the bound sheet stack P**3** by a fixed amount, the stack conveying roller **69***b* stops the conveyance of the bound sheet stack P**3**, with the bound sheet stack P**3** being pressurized by the entrance drive roller **69***a* of the entrance guide **67**.

Next, the bound sheet stack P**3** is held by a gripper unit **70** and conveyed to a discharge belt **71**. By being conveyed while held, the bound sheet stack P**3** reliably reaches the discharge belt **71**. The gripper unit **70** is provided on a support plate **141** shown in FIG. **9**. The support plate **141** is provided on a pair of belts **144** each stretched between a pair of pulleys **142** and **143**. The pulleys **142** are adapted to rotate by a horizontal movement motor **79**. Thus, the gripper unit **70** is adapted to move horizontally as seen in FIGS. **8**A through **8**C and FIG. **9** by the horizontal movement motor **79**.

The gripper unit **70** has a holding member **145** that holds the bound sheet stack P**3** together with a rotation guide gear **78**. The holding member **145** is urged toward the rotation guide gear **78** by a spring **146**. Further, the holding member **145** is to be separated from the rotation guide gear **78** against the resilient force of the spring **146** through the rotation of a nip releasing motor **147**.

The bound sheet stack P**3** conveyed to the discharge belt **71** is pressurized in the direction indicated the arrows in FIG. **8**B by a surface presser unit **72** capable of moving toward and away from the bound sheet stack by a motor (not shown), and is also pressurized by an air vent unit **73** capable of moving toward and away from the bound sheet stack by the motor of the surface presser unit **72**. In this way, after the operation of pressurizing the surface of the bound sheet stack P**3** and the air vent operation have been effected on the bound sheet stack P**3**, the CPU **200** (see FIG. **15**) releases the holding of the bound sheet stack P**3** by the gripper unit **70**, and causes the discharge belt **71** to run in the direction indicated by the arrows in FIG. **8**B by a motor (not shown). Thereafter the CPU **200** causes a glued end portion P**3***a* of the bound sheet stack P**3** to abut a vertical movable registration plate **74**, performing registration operation on the bound sheet stack P**3**. That is, skew feed correction is effected on the bound sheet stack P**3**.

At the same time, a discharge sensor **75** detects the glued end portion P**3***a* of the bound sheet stack P**3**, so that the CPU **200** causes the discharge belt **71** to run for a predetermined period of time based on the detection signal thereof before stopping the running. Then, the CPU **200** moves the gripper unit **70** to the rotation center position of the bound sheet stack P**3** and stops it there, causing the gripper unit **70** to hold the bound sheet stack P**3**.

After the gripper unit **70** has held the bound sheet stack P**3**, the rocking motor **62***a* shown in FIG. **8**A is started. When the rocking motor **62***a* is started, the torque of the rocking motor **62***a* is transmitted to a rocking drive step gear (not shown) from the rocking ascent/descent gear **62***b* through the rocking ascent/descent belt **62***c*, and further, transmitted to a link mechanism (not shown) through a rocking drive belt (not shown) stretched between the rotation shaft **63** and the link shaft **64**, with the rotation shaft **63** constituting the rotation center, whereby the right-hand end, as seen in FIG. **8**C, of the rocking unit **61** descends. The descent of the rocking unit **61** is detected through detection of the protrusion **65** of the rocking unit **61** effected by a horizontal sensor **66***b*. Upon receiving a signal indicating the detection of the protrusion **65** from the horizontal sensor **66***b*, the CPU **200** stops the rocking motor **62***a*. The rocking unit **61** is on standby at the position shown in FIG. **8**C.

As shown in FIG. **8**C, the gripper unit **70** holds the bound sheet stack P**3**, and is moved in the direction indicated by the arrows by the horizontal movement motor **79** (see FIG. **9**). The bound sheet stack P**3** is conveyed to a predetermined position inside the trimmer unit D, and then cut. The end portion of the bound sheet stack P**3** thus cut is parallel to the glued end portion P**3***a*.

After the cutting of the bound sheet stack P**3** is effected by the trimmer unit D, the gripper unit **70** moves, as shown in FIG. **9**, to a predetermined rotating position while holding the bound sheet stack P**3**. Upon reaching the rotating position, the gripper unit **70** causes the bound sheet stack P**3** to rotate by 90 degrees in the direction indicated by the arrows in FIG. **9**. The gripper unit **70** is to be rotated by receiving the torque of the rotation motor **76** shown in FIG. **8**C through the rotation gear **77** and the rotation guide gear **78**.

After rotating the bound sheet stack P**3** by 90 degrees, the gripper unit **70** temporarily moves the bound sheet stack P**3** away from the trimmer unit D in order to grasp the relationship between the position where the bound sheet stack P**3** is held and the next cutting position, causing the discharge sensor **75** to detect the end portion of the bound sheet stack P**3**. When the discharge sensor **75** detects the end portion of the bound sheet stack P**3**, the gripper unit **70** conveys the bound sheet stack P**3** into the trimmer unit D again. The trimmer unit D cuts the end portion of the conveyed bound sheet stack P**3** again. At this time, the end portion to be cut by the trimmer unit is at right angles with respect to the glued end portion P**3***a*.

After the completion of the cutting, the gripper unit **70** conveys the bound sheet stack P**3** to the predetermined rotating position again, and this time causes the bound sheet stack P**3** to rotate by 180 degrees by the same rotating operation and in the same rotating direction as described above.

The gripper unit **70** has grasped the positional relationship between the position where the bound sheet stack P**3** is held and the end portion of the bound sheet stack P**3** in the foregoing cutting, so that, after rotating the bound sheet stack P**3** by 180 degrees as described above, the gripper unit **70** conveys it again to the cutting position. The trimmer unit D again cuts the end portion of the conveyed bound sheet stack P**3**. At this time, the end portion to be cut by the trimmer unit is the remaining end portion at right angles with respect to the glued end portion P**3***a*.

The gripper unit **70** rotates the bound sheet stack P**3** cut in three directions again by 90 degrees by the same operation, and the glued end portion P**3***a* of the bound sheet stack P**3** is conveyed to the position where detection by the discharge sensor **75** is to be effected.

When the glued end portion P**3***a* of the bound sheet stack P**3** is detected by the discharge sensor **75**, the gripper unit **70** cancels the holding of the bound sheet stack P**3**, and the surface presser unit **72** pressurizes the bound sheet stack P**3**. Thereafter, the discharge belt **71** runs counterclockwise as seen in FIG. **8**B, and discharges the bound sheet stack P**3** onto the stacking tray E.

(Trimmer Unit)

Next, the trimmer unit D will be described with reference to FIGS. **10**, **11**A, **11**B, and **12**. The trimmer unit D is adapted to cut the bound sheet stack P**3** conveyed from the rotation stage **60**. The rotation stage **60** is an example of a transport means. The construction composed of the rotation stage **60**, the trimmer unit D, etc. is an example of the sheet cutting apparatus.

The trimmer unit D shown in FIG. **10** is equipped, for example, with a cutting blade **80**, which is an edged tool for cutting the bound sheet stack P**3**. The cutting blade **80** is formed as a plate, and only one side of which is sloped. The longitudinal length of the plate-like cutting blade **80** is larger than the maximum size of the sheet to be cut, and is long enough to be constantly placed on the bound sheet stack P**3** for further longitudinal movement.

A longitudinal movement member **81** has the cutting blade **80**, and is supported on a vertical movement member **82** by rollers **82***a* and **82***b*. The longitudinal movement member **81** is adapted to move in the longitudinal direction thereof and parallel to the cut surface of the bound sheet stack P**3** by being guided by the rollers **82***a* and **82***b* provided on the vertical movement member **82** and abutment portions **81***a* and **81***b* formed in the longitudinal movement member **81** itself. Further, when a horizontal motor **83** rotates, a rotation cam **84** rotates, and a protrusion **84***a* formed on the rotation cam **84** is engaged with a rotation receiver **89** in the form of an elongated hole formed in the longitudinal movement member **81**

itself, whereby the rotating movement of the horizontal motor **83** is converted to a linear reciprocating motion to thereby effect parallel movement in the longitudinal direction of the longitudinal movement member **81**. Velocity adjustment for the reciprocating motion can be freely effected by providing the horizontal motor **83** with an encoder.

The movement of the cutting blade **80** in the thickness direction of the bound sheet stack P**3** is effected by the vertical movement member **82**. The vertical movement member **82** is guided by guide shafts **131** protruding therefrom and guide grooves **135** formed in columns **134** provided on a base **132**, and moves along the columns **134**, moving toward and away from the bound sheet stack P**3**. The vertical movement member **82** is provided with the rollers **82***a* and **82***b* supporting the longitudinal movement member **81**, so that, when the vertical movement member **82** itself moves vertically, the longitudinal movement member **81** also moves vertically, and the cutting blade **80** also moves vertically. Further, in order to impart load (cutting force) to the cutting blade **80**, the longitudinal movement member **81** is constantly pulled toward the bound sheet stack P**3** by tension springs **87***a* and **87***b* through the vertical movement member **82**.

As shown in FIG. **11**A, when a cam **91** rotates through rotation of a vertical motor **88**, and a link **90** moves to a position near a lower supporting point, a sheet presser **93** comes into contact with the bound sheet stack P**3**, and by a further push-down force of the link **90** exerted against the resilient force of a sheet presser spring **92**, the bound sheet stack P**3** is pressed against a mat **94**. While the link **90** moves to the lower supporting point, a mounting member **136** of the link **90** is separated from an abutment portion **82***c* of the vertical movement member **82**, and the cutting blade **80** pressurizes the bound sheet stack P**3** by the tension springs **87***a* and **87***b* through the vertical movement member **82**.

Thus, as shown in FIG. **11**B, the mechanism for operating the sheet presser **93** and the cutting blade **80** also functions as follows: when the cam **91** rotates, and the link **90** moves to the upper supporting point to cancel the pressurization of the bound sheet stack P**3** effected by the sheet presser **93**, the mounting member **136** of the link **90** abuts the abutment portion **82***c* of the vertical movement member **82**, causing the cutting blade **80** to move upwardly in the thickness direction of the bound sheet stack P**3** through the vertical movement member **82**. Due to these functions, the cutting blade **80** can reciprocate in the thickness direction of the bound sheet stack.

Further, as shown in FIG. **10**, the abutment portion **82***c* of the vertical movement member **82** is equipped with a blade position sensor flag **86**. Further, one of the columns **134** is provided with a blade position sensor **85** for detecting the blade position sensor flag **86**. The cutting of the bound sheet stack P**3** by the cutting blade **80** is conducted until the blade position sensor **85** detects the blade position sensor flag **86**.

Under the bound sheet stack P**3**, there is provided, for example, the mat **94** as the cutting blade **80** receiving means for the purpose of preventing damage of the cutting blade **80**. The mat **94** of this embodiment is formed as a roller. The mat **94** is adapted to rotate in the direction indicated by the arrows in FIG. **12**. Due to this configuration of the mat **94**, it is possible to drop, through rotation, cut sheet dust P**4** after the cutting into, for example, a dust box **97** as a dust storing means. From the viewpoint of preventing damage of the cutting blade **80**, it is desirable for the mat **94** to be formed of a soft material, such as rubber, urethane, or molding.

(Operation of the Trimmer Unit)

The bound sheet stack P**3** shown in FIG. **8**A is conveyed to the trimmer unit D from the rotation stage **60** by the gripper unit **70**. As shown in FIG. **10**, the trimmer unit D causes the vertical motor **88** to start, and rotates the cam **91** until the link **90** reaches the lower supporting point. The link **90** brings the sheet presser **93** into contact with the bound sheet stack P**3** through the sheet presser spring **92**. The sheet presser spring **92** is compressed and presses the bound sheet stack P**3** against the mat **94** with the sheet presser **93**.

At this time, the link **90** operates with the sheet presser **93**, with the result that the mounting member **136** moves away from the abutment portion **82***c* of the vertical movement member **82**. Accordingly, the vertical movement member **82** is pulled by the tension springs **87***a* and **87***b* to descend following the mounting member **136**. As a result of the descent of the mounting member **136**, the cutting blade **80** descends, and comes into contact with the bound sheet stack P**3**.

After the cutting blade **80** comes into contact with the bound sheet stack P**3**, the horizontal motor **83** shown in FIG. **10** is started. The rotating motion of the horizontal motor **83** is converted to a reciprocating motion by the rotation cam **84**, the protrusion **84***a*, and the rotation receiver **89**. Thus, the longitudinal movement member **81** vertically reciprocates integrally with the cutting blade **80** in the thickness direction of the bound sheet stack. That is, the cutting blade **80** reciprocates horizontally as seen in FIG. **10**. By the reciprocating movement, the cutting of the bound sheet stack P**3** is started. The cutting blade **80** is pulled by the tension springs **87***a* and **87***b*, and moves in the thickness direction of the bound sheet stack P**3** while cutting the bound sheet stack P**3**. The cutting of the bound sheet stack P**3** through the reciprocating movement of the cutting blade **80** is conducted until the blade position sensor flag **86** is detected by the blade position sensor **85**.

After the completion of the cutting of the bound sheet stack P**3**, the vertical motor **88** is rotated again to rotate the cam **91** until the link **90** reaches the upper supporting point, thereby moving the sheet presser **93** away from the bound sheet stack, and at the same time, moving the cutting blade **80** away from the mat **94**. The cut sheet dust P**4** is partly dropped into the dust box **97** as shown in FIG. **12**, but is partly allowed to remain on the mat **94**. In view of this, the mat **94** is rotated in the direction indicated by the arrows in FIG. **12** by a mat rotating motor **95***a* through a mat drive belt **95***b*. Then, the cut sheet dust P**4** falls in front of a pusher **96** in the dust box **97** without remaining on the mat **94**.

Thereafter, the cut sheet dust P**4** is pushed toward the downstream side in the dust box **97** by the pusher **96**. After the dust disposal rotational operation of the mat **94**, the bound sheet stack P**3** is rotated again by 90 degrees as described above, and the end portions of the three sides other than the glued portion are cut. Finally, the bound sheet stack P**3**, cut in the end portions of the three sides, is discharged onto the stacking tray E.

The operation procedures for controlling the position at which the bound sheet stack is cut by the trimmer unit D constructed as above of this embodiment will be described with reference to FIGS. **8**A through **8**C, **9**, **13**, **14**, and **15**. The CPU **200** performs two kinds of cutting processing described below based on the length of the shorter sides of the bound sheet stack P**3**.

FIG. **13** is a plan view for illustrating the procedures by which the bound sheet stack is cut by the rotation stage **60** (see FIGS. **8**A through **8**C) and the trimmer unit D. Symbols S**1** through S**5** indicate positions of the same bound sheet stack. Arrows B**1** through B**6** indicate the moving and rotating directions of the bound sheet stack. Symbol P**3***a* indicates the glued end portion of the bound sheet stack.

Symbol M indicates the length of the cutting blade **80**, and symbol Ls indicates the length of the shorter sides of the bound sheet stack P**3**. The CPU **200** causes the gripper unit **70** to operate in the trimmer unit D, and the bound sheet stack P**3** on the rotation guide gear **78** (see also FIGS. **8**A through **8**C) is pressed against the rotation guide gear **78** by the holding member **145** of the gripper unit **70** to rotate the rotation guide gear **78**, thus causing the end portion to be cut of the bound sheet stack P**3** to be opposed to the cutting blade **80**. Then, the bound sheet stack P**3** is conveyed to the cutting blade **80** to perform the cutting of the end portion. The CPU **200** cuts the end portions of the three sides of the bound sheet stack by the procedures described above. For example, the longer sides of the bound sheet stack P**3** will be referred to as h, and the shorter sides thereof as k and j. After the end portion as one longer side h of the bound sheet stack is cut, the orientation of the bound sheet stack P**3** is changed by a method described below, and the end portions as the two shorter sides k and j are cut.

In executing the cutting processing control of this embodiment of the present invention, the CPU **200** performs comparison with the length M of the cutting blade M based on the size data of the bound sheet stack P**3** previously stored in the RAM **202**. Next, to be described will be the cutting processing in the case in which it is determined by the CPU **200** that the length Ls of the shorter sides k and j of the bound sheet stack P**3** shown in FIG. **13** is not larger than half of the length M of the cutting blade **80**, that is, not larger than (½)M. As to the cutting processing in the case in which the length Ls of the shorter sides k and j exceeds (½)M, it will be described below with reference to FIG. **14**.

First, although not shown, the CPU **200** causes the gripper unit **70** to operate to pressurize the portion of the bound sheet stack P**3** near the center thereof by the gripper unit **70**, and moves the bound sheet stack P**3** to the cutting blade **80**, thus cutting the end portion h of the bound sheet stack P**3** by the cutting blade **80**. Thereafter, the bound sheet stack P**3** is returned to the position indicated by symbol S**1**, and the portion of the bound sheet stack P**3** to be pressurized by the gripper unit **70** is changed to the end portion h.

The CPU **200** operates the rotation motor **76**, and rotates the bound sheet stack P**3** by 90 degrees by the rotation guide gear **78** to rotate it to the position indicated by symbol S**1** to the position indicated by symbol S**2** (B**1**). Then, the bound sheet stack P**3** is linearly moved to the position indicated by symbol S**3** by the gripper unit **70** (B**2**), and the end portion as the shorter side k of the bound sheet stack P**3** is cut by using the left half of the cutting blade **80**. After cutting the end portion as the shorter side k of the bound sheet stack P**3** using by using the left half of the cutting blade **80**, the CPU **200** restores the bound sheet stack P**3** to the position indicated by symbol S**2** by the gripper unit **70** (B**3**).

Next, the CPU **200** operates the rotation motor **76**, and rotates the bound sheet stack P**3** by 180 degrees by the rotation guide gear **78**, causing it to rotate from the position indicated by symbol S**3** to the position indicated by symbol S**4** (B**4**). Then, the bound sheet stack P**3** is linearly moved from the position indicated by symbol S**4** by the gripper unit **70** (B**5**), and the end portion as the shorter side j of the bound sheet stack P**3** is cut by using the right half of the cutting blade **80**. After cutting the end portion as the shorter side j of the bound sheet stack P**3** by using the right half of the cutting blade **80**, the CPU **200** returns the bound sheet stack P**3** to the position indicated by symbol S**4** by the gripper unit **70** (B**6**), and rotates it to the position indicated by symbol S**1** to thereby complete the cutting of the end portions of the three sides of the bound sheet stack P**3**.

In this way, when the length of the shorter sides of the bound sheet stack P**3** is not larger than half of the length M of the cutting blade **80** ((½)M), the trimmer unit D of this embodiment cuts the end portion of one side of the bound sheet stack P**3** using by the left half of the cutting blade **80**, and cuts the end portions of the other side by using the right half of the cutting blade **80**, whereby it is possible to uniformly use the cutting blade **80** over its entire length, thereby preventing partial wear of the cutting blade **80** and making it possible to use the cutting blade **80** for a longer period of time than in the prior art.

Next, the cutting of the bound sheet stack when the length Ls of the shorter sides of the bound sheet stack P**3** exceeds half of the length M of the cutting blade **80** ((½)M), that is, ((½)M<Ls), will be described with reference to FIG. **14**. The symbols used in FIG. **14** indicate the same things as those in FIG. **13**.

First, although not shown, the CPU **200** operates the gripper unit **70** to pressurize the portion of the bound sheet stack P**3** near the center thereof, and moves the bound sheet stack P**3** to the cutting blade **80**, thus cutting the end portion h of the bound sheet stack P**3** by the cutting blade **80**.

Thereafter, the CPU **200** restores the bound sheet stack P**3** to the position indicated by symbol S**10**, and changes the position where the bound sheet stack P**3** is pressurized by the gripper unit **70** to a position spaced apart from the glued end portion P**3***a* of the bound sheet stack P**3** by the distance (½)M. Then, the CPU **200** operates the rotation motor **76**, and rotates the rotation guide gear by 90 degrees, moving the bound sheet stack P**3** from the position indicated by symbol S**10** to the position indicated by symbol S**20** (B**10**). At this time, at the position indicated by symbol S**20**, the outer longer side (which, in the drawing, is the glued end portion P**3***a*) is in the same straight line as the left-hand end of the cutting blade **80**. Thereafter, the CPU **200** performs cutting processing in the same manner as that of the cutting processing shown in FIG. **13** described above.

That is, the CPU **200** linearly moves the bound sheet stack P**3** to the position indicated by symbol S**30** by the gripper unit **70** (B**11**), and cuts the end portion as the shorter side k of the bound sheet stack P**3**. Thereafter, the CPU returns the bound sheet stack P**3** to the position indicated by symbol S**20** (B**12**), where the CPU **200** rotates the bound sheet stack P**3** by **180** degrees to move it to the position indicated by symbol S**40**. Next, the CPU **200** linearly moves the bound sheet stack P**3** to the position indicated by symbol S**50** by the gripper unit **70** (B**14**), and cuts the end portion as the shorter side j of the bound sheet stack P**3**. Thereafter, the CPU **200** returns the bound sheet stack P**3** to the position indicated by symbol S**40** (B**15**), and rotates it to the position indicated by symbol S**10** to complete the cutting of the end portions of the three sides of the bound sheet stack P**3**.

In this way, when ((½)M)<Ls, the cutting of the two shorter side end surfaces is effected in a positioning such that the longer side of the bound sheet stack P**3** is aligned with an end of the cutting blade **80** in the drawing, whereby it is possible to effect the cutting processing in two cutting. operations, using the cutting blade **80** over its entire length, that is, from end to end. Thus, while the central portion of the cutting blade **80** is worn to a somewhat by a degree larger than that of the end portions thereof, it is possible to use the cutting blade **80** substantially uniformly over its entire length, thereby preventing partial wear of the cutting blade **80** and making it possible to use the cutting blade **80** for a longer period of time than in the prior art.

As described above, two kinds of cutting processing are conducted based on the size data of the bound sheet stack P**3**

previously stored in the RAM **202**: when ((½)M≧Ls), the cutting processing as described with reference to FIG. **13** is conducted in which the bound sheet stack P**3** is rotated around its end as an axis and transferred; when ((½)M<Ls), a cutting processing is conducted in which the bound sheet stack P**3** is rotated around the position spaced apart from the glued end portion P**3***a* by the distance (½)M. The CPU **200** compares the value of the length Ls of the shorter sides of the bound sheet stack with the value of half of the length M of the cutting blade, (½)M, and performs one of the two kinds of cutting processing based on the comparison result. Regarding the size data, size data designated at the operating portion of the main body is received by a communication device **209**, and stored in the RAM **202**.

While in the above embodiment the end portion h of the bound sheet stack is pressurized by the gripper unit **70**, and rotated clockwise before transferring it, the portion to be pressurized may also be the end surface on the glued portion side, and the rotation may also be effected counterclockwise.

While the rotation of the bound sheet stack P**3** is effected at the position indicated by symbol S**1** in FIG. **13** or the position indicated by symbol S**10** in FIG. **14**, the rotation may be effected at any position as long as rotation is possible through pressing the bound sheet stack P**3** on the rotation stage **60**.

While this embodiment adopts the press-and-cut system in which the cutting blade **80** is vertically moved up to the sheet presser **93**, it is also possible to adopt a guillotine system in which a vertically movable upper cutter and a stationary lower cutter are used, or a slide system in which the cutting blade **80** horizontally reciprocates.

In this embodiment, the axis around which the bound sheet P**3** is rotated is changed in order to change the cutting position based on the size of the bound sheet stack P**3**. Apart from this, a method is available in which there is simply provided a driving motor that moves the bound sheet stack P**3** parallel to the cutting blade **80**, making it possible to move the bound sheet stack P**3** in a direction perpendicular to and in a direction parallel to the cutting blade **80** and effecting the shift of the cutting position simply by conveyance through motor drive.

In the sheet cutting apparatus of this embodiment, the sheet to be cut is rotated by a transport means, so that it is possible to uniformly use the cutting blade, changing the portion of the cutting blade to be used, thereby making it possible to use the cutting blade for a long period of time.

Further, in the sheet cutting apparatus of this embodiment, the cutting blade can be used for a long period of time, so that the number of times for replacing the cutting blade is reduced, thereby enhancing the operating efficiency (availability ratio) of the apparatus.

In the sheet cutting apparatus of this embodiment, based on the size of the sheet to be cut, a transport means selectively holds the portion of the sheet to be cut which is a central position of the sheet to be cut with respect to a direction crossing the conveying direction of the sheet to be cut and which is an arbitrary position along the conveying direction of the sheet to be cut, and the sheet to be cut is rotated around the held portion to cause an end portion of the sheet to be cut to be opposed to the cutting blade, so that it is possible to use the portions of the cutting blade on both sides with respect to the central position substantially uniformly.

The sheet aftertreatment apparatus of this embodiment is equipped with a sheet cutting apparatus in which the number of times for replacing the cutting blade is reduced, thereby making it possible to achieve an improvement in terms of operating efficiency (availability ratio).

The image forming apparatus of this embodiment is equipped with a sheet aftertreatment apparatus of high operating efficiency (availability ratio), so that it is possible to achieve an improvement in terms of productivity in image formation.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

What is claimed is:

1. A sheet cutting apparatus comprising:

a cutting blade which cuts a sheet to be cut, the sheet to be cut including a sheet or a sheet stack;

transport means for holding and rotating the sheet to be cut to cause an end portion of the sheet to be cut to be opposed to the cutting blade and transporting the sheet to be cut to a position in which the end portion is cut by the cutting blade; and

selecting means for selecting a central position of the sheet to be cut with respect to a direction intersecting with a conveying direction in which the sheet to be cut is conveyed and an arbitrary position of the sheet to be cut along the conveying direction in accordance with a size of the sheet to be cut,

wherein the transport means holds a portion of the sheet to be cut in a selected central position and in a selected arbitrary position of the sheet to be cut.

2. A sheet aftertreatment apparatus comprising:

alignment means for aligning at least one side as an end portion of a sheet stack; and

a sheet cutting apparatus as recited in claim **1** for cutting the sheet stack aligned by the alignment means.

3. A sheet aftertreatment apparatus comprising:

a sheet cutting apparatus as recited in claim **1**; and

supply means for supplying the sheet to be cut to the transport means, with a central position of the sheet to be cut with respect to a direction intersecting with a supplying direction of the sheet to be cut being matched with the central position of the sheet to be cut with respect to the direction intersecting with the conveying direction of the sheet to be cut in the transport means of the sheet cutting apparatus.

4. A sheet aftertreatment apparatus comprising:

a sheet cutting apparatus as recited in claim **1**; and

supply means for supplying the sheet to be cut to the transport means, with a central position of the sheet to be cut with respect to a direction intersecting with a supplying direction of the sheet to be cut being matched with the central position of the sheet to be cut with respect to the direction intersecting with the conveying direction of the sheet to be cut in the transport means of the sheet cutting apparatus.

5. An image forming apparatus comprising:

image forming means for forming an image on a sheet; and

a sheet aftertreatment apparatus as recited in any one of claims **2**, **3**, or **4** for cutting the sheet to be cut on which the image has been formed by the image forming means.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,413,360 B2
APPLICATION NO. : 11/083933
DATED : August 19, 2008
INVENTOR(S) : Toshiki Kikuchi

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

ON THE TITLE PAGE:
At Item (56), Foreign Patent Documents, "2003071780 A" should read --2003-071780--.

COLUMN 1:
Line 17, "etc." should read --etc.,--.
Line 25, "etc." should read --etc.,--.

COLUMN 3:
Line 52, "and" should read --and a--.

COLUMN 5:
Line 1, "two-side" should read --two-sided--.
Line 3, "switch back" should read --switch-back--.

COLUMN 6:
Line 20, "etc." should read --etc.,--.
Line 21, "etc." should read --etc.,--.

COLUMN 7:
Line 41, "since" should read --elapses from--.

COLUMN 11:
Line 9, "indicated" should read --indicated by--.

COLUMN 12:
Line 47, "etc." should read --etc.,--.

COLUMN 15:
Line 49, "using" should be deleted.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,413,360 B2
APPLICATION NO. : 11/083933
DATED : August 19, 2008
INVENTOR(S) : Toshiki Kikuchi

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

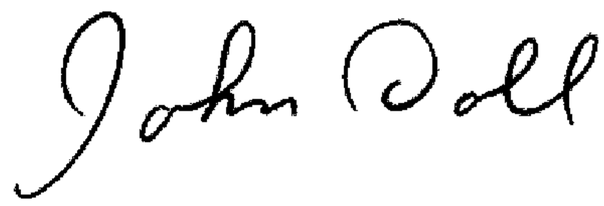
COLUMN 16:

Line 5, "using by" should read --by using--.

Line 60, "a somewhat by a degree larger" should read --a somewhat larger degree--.

Signed and Sealed this

Tenth Day of March, 2009



JOHN DOLL
Acting Director of the United States Patent and Trademark Office